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MEDIATED ACTIVITY AND THE ROLE OF TECHNOLOGY IN PEER-TO-PEER LEARNING AT THE UNIVERSITY OF FORT HARE

Submitted in partial fulfilment of the requirements for the degree of Masters in Philosophy (Education and ICT)

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Abstract

The following calls for research into the ways in which South African university students use technology for peer-to-peer learning (Czerniewicz and Brown, 2005). This study aims to explore the ways in which students mediate one another's learning and the ways in which they use (and don't use) information and communications technology (ICT) to do so. This study provides a snapshot of eleven University of Fort Hare students' peer-to-peer learning strategies. In exploring this phenomenon in context, the social and cultural factors are analysed using Activity Theory, most notably building on the work of Sharples et al (2007).

Semi-structured interviews were conducted with students identified as early adopters of ICT for peer-to-peer learning, selected from 375 respondents to the *Access and Use* Survey questionnaire (Czerniewicz and Brown, 2007). An analytical framework was developed using categories developed from high-level Activity Theory concepts. Sub-categories were developed using key concepts from Sharples, Taylor and Vavoula (2007), Laurillard's (2003) work, as well as, inductively and deductively in relation to the data, following Hardman's (2008) approach.

Three key peer-to-peer learning patterns were identified: A group of students preparing for an exam or a test were found to adopt *cooperative learning* strategies, while students working together towards a tangible output, such as an assignment, adopted *collaborative learning* strategies. *Peer-to-peer tutoring* was found to occur where one student is assisted by a more-able peer. Most interviewees' peer-to-peer learning activities were found to occur face-to-face, and the extent and level of interviewees' ICT use was less than anticipated.

The findings are not generalisable beyond this small sample, but serve to advance understanding of the processes involved in students' peer-to-peer learning practices.

Key words: Peer-to-peer learning; ICT; Activity Theory

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Plagiarism declaration

I, Joy Olivier, hereby declare that the work contained in this dissertation is my own work, and that it has not been submitted for any degree or examination at any other university.

Signed: Date: 22 November 2009

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Declaration by candidate for the degree of Master in the Faculty of Humanities

I, Joy Olivier of 210a Longmarket Street, Bo Kaap, do hereby declare that I empower the University of Cape Town to produce for the purpose of research either the whole or any portion of the contents of my dissertation entitled *Mediated Activity and the Role of Technology in Peer-to-Peer Learning at the University of Fort Hare* in any manner whatsoever.

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Acronyms

ALN	Asynchronous Learning Networks
AT	Activity Theory
Badmin	Bachelor of Business Administration
BComm	Bachelor of Commerce
BEd	Bachelor of Education
BSC	Bachelor of Science
CD	Compact Disc
CET	Centre for Educational Technology
CHAT	Cultural Historical Activity Theory
CMC	Computer Mediated Communication
CPUT	Cape Provincial University of Technology
CSCL	Computer Supported Collaborative Learning
DP	Duly Performed
EL	East London
FHU	Fort Hare University
ICT	Information and communications technology
LAN	Local Area Network
IM	Instant messaging
IS	Information Systems
Mxit	Mix it
P2P	Peer-to-peer
PC	Personal Computer
RAU	Rand Afrikaans Universiteit
SME	Small or medium enterprise
SMS	Short message service
UCT	University of Cape Town
UNISA	University of South Africa
VoIP	Voice over Internet Protocol
WAN	Wide Area Network
ZPD	Zone of Proximal Development

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Chapter 1

An overview of the study

1.1 Introduction

With one foot in the grassy field of educational technology (overgrown with a variety of species[1]), and another in the (equally ecologically complex[2]) field of peer-to-peer learning, this study aims to explore how Fort Hare University students learn together, and the role of ICT in these peer-to-peer interactions.

Peer-to-peer learning involves interpersonal interactions, with collectives of students working on tasks. For the purposes of this study, students in a similar age cohort to the interviewees (within five years of age) were categorised as "peers". Although usually classmates, in some instances they are at a higher level of study and sometimes they are hired by the university in a formal capacity as a tutor.

This study of peer-to-peer learning was prompted by data collected in 2007 for the *Access and Use* survey (Czerniewicz and Brown, 2009). The study aims to provide deeper insight into a phenomenon to which the Survey attends briefly: the nature and extent of students' use of ICT for peer-to-peer learning purposes. Through qualitative research (semi-structured interviews) focused on students' self-reported experiences of ICT-enabled peer-to-peer learning, this study explores the ways in which students mediate one another's learning and the ways in which they use (and don't use) ICT to do so. In order to explore this phenomenon in context, the social and cultural factors that impact peer-to-peer learning are analysed using Activity Theory.

This study provides a snapshot of eleven Fort Hare students' peer-to-peer learning strategies, and their use of technology to support these. The findings are not generalisable beyond this small sample, but serve to advance our understanding of the processes involved in Fort Hare students' peer-to-peer learning practices. They should be regarded primarily as a source of hypotheses for further investigation.

1.2 Rationale

> *A society which is mobile, which is full of channels for the distribution of a change occurring anywhere, must see to it that its members are educated to personal initiative and adaptability. Otherwise, they will be overwhelmed by the changes in which they are caught and whose significance they do not perceive (Dewey, 1916, cited by Sharples et al, 2007).*

South Africa's capacity challenges are greatly impacting every facet of our lives - from the delivery of essential services such as education and health, to unemployment, poverty and the stability of our economy. The need for skilled human resources is great, and without a dramatic increase in young black professionals, our transformation agenda is at risk (Fiske and Ladd, 2004; CDE, 2007; Lam, Ardington and Leibbrandt, 2008). Our tertiary institutions present us with the chicken and the egg: We need them to produce skilled human resources, and yet the capacity issues with which they're grappling themselves make meeting this demand very challenging.

These South African complexities play out within the constant shifts brought about by

1 The field sprouts a variety of theoretical approaches and foci. The terms used to capture some of these include Instructional design, Community Informatics, eLearning, Networked Learning, Mobile Learning, Digital Media Studies, etc.

2 A range of issues are highlighted in the literature on peer-to-peer learning, including mediation, peer learning and assessment, peer tutoring, cooperative learning, collaborative learning, etc.

globalisation. The information, communication and technology age demands new skills and capacities, and, in turn, presents abounding challenges and opportunities.

Fort Hare University aims to produce the young black professionals that South Africa needs to lead us into this new age. The responsibility for achieving this is a heavy weight, and university staff are stretched (UFH, 2000). Peer-to-peer learning is a relatively under-explored phenomenon that may help to lighten the load, and ICT could potentially both promote and enable peer-to-peer learning that equips students with the skills and abilities they need to navigate this new era[3].

Underwood and Underwood (1999, p.13) write that "learning in groups and with peers may be a more effective way of achieving some educational goals (e.g. conceptual change) than individualised instruction." They cite evidence which demonstrates that "both peer tutoring and peer collaboration can facilitate learning and development." And note that "we are only just beginning to identify the components of effective peer interaction". In *Mind and Society* (1978) Vygotsky identifies the very interesting and important link between the tools we use and our interpersonal and intrapersonal speech for facilitating learning.

The need for research in the area of ICT-enabled peer-to-peer learning has been identified by a number of researchers, including those whose work spans the South African higher education landscape. In their study of access to and use of ICT in tertiary institutions in the Western Cape, Czerniewicz and Brown (2005) found that students report extensive use of communicative media that does not translate into their learning activities. They raise questions about the role of ICT in the informal learning process, and although the study does not specifically address the role of peer learning, they note the need for further exploration of this phenomenon.

The human resource development and inequality challenges facing South Africa are large. Both peer-to-peer learning and ICT offer potential avenues for overcoming these challenges. A deeper understanding of peer-to-peer learning and the role of ICT will be useful for informing interventions aiming to leverage these phenomena to improve education in South Africa, and this is the rationale behind the research question in this study.

1.3 Research sites

Fort Hare University is in the Eastern Cape of South Africa. The province faces some of the largest socio-economic challenges in the country, with high unemployment and HIV infection rates, and the majority of the population living in poverty (Stats SA, 2007).

The Eastern Cape became a South African Province in 1994 and incorporated areas from the former homelands of the Transkei and Ciskei as well as, what was then, the Cape Province. Although Port Elizabeth and East London have well-developed economies, driven largely by the automotive industry, the province remains one of the poorest in South Africa, with extreme poverty in the former homelands (Stats SA, 2007).

The original Fort Hare was established in 1846 as a military base for the colonial invasion and conquest of the Ciskeian Xhosa Chiefdoms, and it was named after Colonel John Hare, Lieutenant-governor of the Eastern Cape Colony in the 1840's. FHU was a key institution in higher education for black Africans from 1916 to 1959 and offered an academically excellent education to students from across sub-Saharan Africa. Many of its alumni were part of independence movements and governments of newly independent African countries, and prominent graduates include two Nobel Peace Prize winners, four presidents, and three Prime ministers (FHU website, 2008, Wikipedia, 2009).

3 With communication, currency, information and knowledge speeding from node to node around the global network, productivity gains have been achieved in sectors from manufacturing to finance and information processing. Castells' thesis posits information and knowledge as key for economic growth. "Development today is, above all, development of the capacity to process knowledge-based information efficiently and apply it to production and to the enhancement of the quality of life" (Castells, 2001).

FHU has three campuses: East London, Alice, and Bisho. Its five faculties and ten schools cover the range from undergraduate diplomas, bachelor's and honours degrees, to masters and doctoral level studies (Wikipedia, 2009 and FHU website, 2008).

The interviewees were based at the East London and Fort Hare campuses, and interviews took place between 22 and 28 July 2008.

Figure 1: Map of the Eastern Cape

1.4 Theoretical framework

Vygotsky's sociocultural understanding of learning underpins the theoretical framework for this study. His notions of mediation and the Zone of Proximal Development (ZPD) are the theories of learning that inform every aspect of this research – from the research questions to the analytical framework.

Vygotsky's approach emphasises the dialectical relationship between social interaction and contextual influences. He believes that learning is located in the interplay between culture and individuals and maintains that learning occurs through interpersonal interaction, and that individuals transform through tasks undertaken in collectives (Vygotsky, 1986, cited by Saljo, 1999, p.149). Peer-to-peer learning involves interpersonal interactions, with collectives of students working on tasks. Vygotsky calls the process through which individuals transform through learning "mediation", and the 'space' in which this occurs "the zone of proximal development". He also places strong emphasis on the role of tools or mediating artefacts in learning. These terms are very briefly defined in appendix A and further explicated in chapter three.

Vygotsky's work was developed by a group of academics who have come to be known as "activity theorists". Engestrom's (1987) development of activity theory into its third generation situates mediated activity in context. It is thus useful for describing and understanding the ways in which students mediate one another's learning. Activity theory provides a theoretical lens with which to explore the role of socio-cultural factors and their dialectical relationship with technology (tools). It zooms in on the rules, community, and division of labour playing out between subjects and community in an activity. Again, these concepts are fully unpacked and

detailed in chapter three.

Sharples, Taylor, and Vavoula's relatively recent (2007) development of activity theory further enhances its relevance for this study. The researchers prise apart the key foci of activity theory (rules, context, and division of labour) by superimposing semiotic and technological layers upon each. Rules and control are regarded in terms of both social norms and human-computer interaction, and the community node includes the physical context. Division of labour shifts slightly from its strong Marxist focus and is termed, instead, "communication", with the semiotic layer addressing conversation and division of labour, and the technological layer comprising communication channels and protocols.

The full development of Vygotsky's work into activity theory and its subsequent elaborations are detailed below in chapter three. They have been briefly noted here in order to provide the reader with a snapshot of this study's theoretical approach and contextualise the research questions that follow.

1.5 Research questions

This study looks at peer-to-peer learning for academic, curriculum-related purposes. Peers are defined as fellow students (usually in a similar age cohort /within five years of age) were categorised as "peers". In some instances they are at a higher level of study and hired by the university in a formal capacity as a tutor, and in others they are a classmate with an equal or lower level of ability than the person with whom they are studying. All the contexts in which peers learn together are considered in this study – from seminar rooms where formal tutoring sessions take place, to rooms in residence where peers study together the night before an examination.

The study aims to address the following questions:

- How do FHU students learn together?
- What, if any, is the role of ICT in these peer-to-peer learning interactions?

The table below maps the sub-questions for each of the above guiding questions.

Key question	**Sub-questions**
How do FHU students learn together?	What strategies do students adopt when learning with their peers? When and why?
	How are peer learning activities mediated?
	What impact do the contextual and sociocultural factors have on how students learn together?
What role do ICTs play?	What ICT do students use for peer-to-peer learning and when?
	What impact does the contextual and sociocultural factors have on how students use ICT for peer-to-peer learning?
	What is the impact of technology on peer-to-peer mediated activity?
	When and, if so, how do ICTs enable or inhibit peer-to-peer learning?

Table 1: Research questions

1.6 Thesis structure

The thesis is structured as follows:

Chapter one introduces the study. It provides an overview of the rationale behind the study, some background on the research sites, and introduces the research questions.

In **chapter two**, literature pertinent to the foci of this study is reviewed. The foci, methodologies, and theoretical approaches of research on peer-to-peer learning and the role of ICT are presented and discussed.

Chapter three outlines the theoretical framework. The first section positions the search for an appropriate theoretical framework within the broad area of Education and ICT. The next provides a brief overview of the study's underpinning theory of learning. Cultural Historical Activity Theory (CHAT), or Activity Theory (AT), which situates this learning in context, is outlined in the section that follows. Sharples et al's (2007) theory of mobile learning, which is essentially a development of third generation activity theory, is presented as the key theory used in this study and described in detail. Finally, the contribution of Laurillard's (2002) work on the role of ICT in teaching-learning processes, and Czerniewicz and Brown's (2005, 2005b, 2008, 2008b) development thereof is outlined as the work of these theorists is used to operationalise some of the high-level concepts in Sharples et al's (2007) model.

The research design and methodology are presented in **chapter four**. The research processes, from sampling to data analysis, are described in this chapter which ends with a discussion of validity and ethics issues in the research design.

In **chapter five**, the data analysis is presented. The chapter is primarily concerned with the application of the theoretical framework for presenting and understanding the data. Three overarching peer-to-peer tutoring activities are described in detail.

A discussion of the study's findings, in light of the literature, appears in **chapter six** which also outlines lessons learned, highlights issues that need to be addressed, and provides suggestions for further research.

Chapter 2

Literature review

2.1 Introduction

In this chapter, the key terms describing the most studied forms of peer-to-peer learning are unpacked. Studies looking at the use of ICT for these types of peer-to-peer learning are then discussed. The review then provides an overview of the foci of peer-to-peer learning studies, as well as the methodologies and theoretical frameworks they use. The aspects of other studies that most inform and shape this dissertation are highlighted in the conclusion of this chapter and detailed in the next.

2.2 Peer-to-peer learning

Theories of learning have been developed over the 2,500 years since Confucius, and peer-to-peer learning practices date back to Aristotle. Wagner (1990) describes its use in Western educational approaches through the seventeenth, eighteenth, and early nineteenth centuries. Foot et al (1990) provide an overview of research on peer-to-peer learning in the 1970s and 1980s, and Mercer and Wegerif (1999, p.81) note the great deal of research into what was termed collaborative learning during the late 1990s.

Increasingly, the field is becoming interdisciplinary and spans cognitive science, psychology, computer science, education, educational psychology, educational technology, communication, social psychology, artificial intelligence, and informatics (Resta and Laferriere, 2007). Studies on peer-to-peer learning vary widely in focus and scope. Whereas some are concerned with peer-to-peer learning between young children, others study the phenomenon in higher education. The scope ranges from small controlled experiments to large surveys, and a myriad of methodologies and theoretical frameworks are employed. Studies concerned with the role of ICT in peer-to-peer learning (Sharples et al, 2007) are discussed in the next section.

Many theorists posit the importance of social or productive interaction and action in learning. Saljo (1999) asserts that "knowledge is not merely stored in our minds; it circulates between us when we communicate with each other in concrete activities" (p.150). And Vygotsky calls the convergence of speech and practical activity[4] "the most significant moment in the course of intellectual development", as it "gives birth to the purely human forms of practical and abstract intelligence" (1978, p.24). Howe and Tolmies' (1999) studies show that the single most important element of productive interaction is "discussion of individual group members' conceptions of the material in hand".

Anderson et al (2000) list the beneficial effects of peer interaction in education. First, they note that interactants articulate their own views and ideas in situations demanding joint activity or agreed solutions. They cite Damon and Phelps (1989) and Doise and Mugny (1984) in their assertion that "socio-cognitive conflict has long been recognised as a promoter of conceptual advance". Second, they cite Beattie (1982) who claims that the absence of a tutor leads to enhanced engagement and less inhibited self-expression. Third, they posit that the need to take responsibility for their own learning leads students to make more effort which encourages 'deep learning' (the authors cite Marton et al, 1984). Finally, they cite Howe et al (1992) and Tolmie et al (1993) who claim that collaboration stimulates reflection that is beneficial for individual learning, and assert that peer interaction is known to improve self-esteem, commitment to work, and mutual concern among interacting students.

While many researchers agree to some extent on the benefits of peer-to-peer learning, in most

4 Vygotsky shows that speech and activity begin as "two ... completely independent lines of development" (1978, p.24).

cases they do not entirely agree on what peer-to-peer learning *is*. Words such as "interaction", "collaboration", "cooperation", and "tutoring" are peppered (often interchangeably) throughout the literature and authors often neglect to explain what it is that they mean. In their book, *Children Helping Children*, Foot et al (1990) describe three main approaches to peer-to-peer learning: *peer tutoring*, *peer collaboration,* and *cooperative learning.* Lehtinen, Hakkarainen, Lipponen, Rahikainen and Muukonen (no date) highlight the distinction between cooperative and collaborative learning as central in their literature review of computer supported collaborative learning (CSCL). They note that "the distinction is based on different ideas of the role and participation of individual members in the activity" (p.3).

Citing Damon and Phelps (1987), Foot et al (1990) differentiate the three approaches they identify "on the basis of two main dimensions of interaction: 'equality' and 'mutuality of engagement'." They note that equality marks "both equivalence of age and stage of cognitive development and equivalence of knowledge or skill in the task or problem to be sold", and that "mutuality of engagement refers to the extent to which the children are 'connected', or 'in tune' with each other or working synchronously on the same aspect of the same problem" (p.8). In this study (following Vygotsky's (1987) lead), the terms "more-able" and less-able" are used to differentiate between students' knowledge or skill. Foot et al (1990) offer Damon and Phelp's neat argument which posits that the three types of peer learning reflect the dimensions of equality and mutuality quite differently: Peer tutoring is relatively low on equality and high on mutuality; cooperative learning is high on equality and low on mutuality; and peer collaboration is high on both".

There are three main approaches to peer-to-peer learning as identified by Foot et al (1990): cooperative learning, collaborative learning, and peer-to-peer tutoring.

1. Cooperative learning

   Lehtinen et al (no date) write that cooperative learning refers to "instructional methods whereby students are encouraged or required to work together on learning tasks" (p.7). The view of learning between peers as an instructional method is widely held in the literature and informs the design of many studies. Much of the research is thus constrained to learning between peers as prescribed top-down from educators, teachers or lecturers, rather than that which sparks naturally between learners or students.

   According to Slavin (1997, cited by Lehtinen et al, no date, p.7), "there is a growing consensus among researchers about the positive effects of cooperative learning on student achievement". However, Lehtinen et al (no date) points to the disagreements about why and under which conditions this occurs. According to Lehtinen et al, there are two contrasting theories about the social benefits of cooperating: Social cohesion theory holds that students help others because they care about them, while motivational theory points to extrinsic awards. An application of social cohesion theory is Aronson's "Jigsaw method", discussed by Lehtinen et al (no date), where learning content is apportioned to subgroups of students who then share their "expertise" with the rest of the group. The premise is that this increases social cohesion, although a typical negative effect the researchers identify is that students do not learn more than their allocated portion.

2. Collaborative learning

   Crook (1999, p.107) defines "collaboration" as "an interaction in which the participants have a particularly focused intent on co-ordinating shared meaning". He explains that

   > a partnership organised for collaborative learning should provoke exchanges in which the need to create a rich structure of mutuality is strongly apparent and self-consciously pursued... Collaborations involve a state of engagement in which people mobilise their natural capacity for building common knowledge and direct it towards some purpose defined by an educational setting (p.114).

Haythornthwaite (2001, p.213) cites Kaye's (1995, p.195) definition of collaborative learning as "the acquisition by individuals of knowledge, skills, or attitudes occurring as the result of group interaction". She lists "active construction of knowledge, problem articulation, and peer-to-peer communication" as "integral components in the collaborative learning process". For Haythornthwaite, collaboration entails working together toward a common goal.

Slotte and Tynjala (cited by Chan et al, 2007, p.60) maintain that necessary skills for effectively engaging in collaborative learning projects are "being active and developing initiative". They write:

> collaboration involves the production of a joint outcome and thus demands sharing and generating new knowledge together with one's peers. In this way, it provides individuals with better opportunities to use higher order thinking skills and problem-solving skills in the construction of their ideas about practice (p.63).

Roth and Lee (2007, p.205) identify the division of labour between peers as a key means of mediated learning which "inherently leads to learning outcomes and forms of societal activity". They highlight the possibility of new or more advanced actions in collective activity in explaining that individuals can learn from collaborating with peers at the same developmental level, rather than with more advanced others (e.g. teachers or parents).

3. Peer-to-peer tutoring

Lehtinen (no date, p.23) cite Doise and Mugny's (1984) argument that learning is more "progressive" when children "with different cognitive strategies work together and engage in conflictual interaction". They briefly refer to several studies on peer-to-peer tutoring which found achievement benefits for the tutor as well as the tutee and highlight Webb's (1989, 1992) studies which found that the students who explain to others gain the most.

Studies on peer-to-peer tutoring look at different kinds of peer tutors. In some, the tutor is a more-able peer in the same class. Others look at reciprocal teaching between peers. For example, Wong et al (2003, citing Palinscar and Brown, 1984) review a study where each learner takes turns to question their peers and summarise the answers. They found that students learn from one another by considering multiple perspectives. In other studies, the peer is a more experienced or slightly older student.

Cooperative and collaborative learning are generally distinguished from each other in the literature, although these types of peer tutoring are defined and studied in very different ways. Roschelle and Teasley (1995, cited by Resta and Laferriere, 2007) state that,

> cooperation is accomplished by the division of labour among participants, as an activity where each person is responsible for a portion of the problem solving... while collaborative learning involves the mutual engagement of participants in a coordinated effort to solve the problem together (p.66).

The extent to which there is limited consensus among researchers that cooperative learning involves the division of labour or apportioning of tasks, there is a similar concurrence that collaborative learning involves learners mutually engaged in a task or problem solving activity.

Lehtinen et al (no date, p.8) cite Scharge's (1990, p.40) definition of collaboration as "the process of shared creation: two or more individuals with complementary skills interacting to create a shared understanding". They write that successful collaborative work requires a "shared space", a culture of collaboration, supporting leadership, common vision, team processes and information support systems, and "involves the mutual engagement of

participants in a coordinated effort to solve the problem together" (p.22).

For some researchers, a goal or output is requisite for peer-to-peer learning to be collaborative. Panitz (1996, cited by Resta and Laferriere, 2007) views collaboration as "a philosophy of interaction to facilitate accomplishment of an end product or goal through people working together in groups" (p.66).

It is difficult to pin-point definitive agreement about cooperative and/or collaborative peer-to-peer learning and/or tutoring in the literature. In some cases, the relative levels of peer learners' age, ability, or skill are included in the definitions and in others they are not. Resta and Laferriere (2007, p.66) acknowledge that collaborative learning is a complex and ill-defined concept. They note that there is no agreement on the meaning of the terms collaborative and cooperative learning, and argue that this disagreement may stem from the different, and sometimes diverging, purposes, goals, and perspectives of educational researchers. They refer to Slavin's (1997) distinction where cooperative learning is associated with well-structured knowledge domains and collaborative learning with ill-structured knowledge domains. (Unfortunately, they do not detail this argument further.)

However, referring to Kirschner (2001), Resta and Laferriere (2007) note that both types of learning share a number of common elements, including:

- Learning is active
- Teaching and learning are shared experiences
- Students participate in small-group activities
- Students take responsibility for learning
- Students reflect on their own assumptions and thought processes
- Social and team skills are developed through the give-and-take of consensus-building

This study aims to answer questions about the ways in which peers learn together (come to know) in the multiple contexts in which they interact with one another. Their use of ICT, or "interactive technologies" for doing so is this study's secondary key concern, and Sharples et al's (2007) definition of mobile learning is pertinent for addressing both. They define mobile learning as "the processes of coming to know through conversations across multiple contexts among [peers] and personal interactive technologies". While this definition refers to the media through which these conversations take place, the ways in which it includes "coming to know through conversations across multiple contexts among peers" is very relevant.

2.3 ICT-enabled peer-to-peer learning

> *One of the basic requirements for education in the future is to prepare learners for participation in a networked, information society in which knowledge will be the most critical resource for social and economic development* (Lehtinen, no date, p.4).

Some entire universities exist solely online, and all ivory towers made from bricks and mortar have a formidable online presence if there's anything worthwhile happening on their campuses. The range and convergence of technologies and their applications in education has sparked an eruption of research, theories, fields of study, and jargon. Research on the use of ICT in higher education occurs in different fields – from Computer Supported Collaborative Learning (explained below), to Asynchronous Learning Networks[5] and Distributed Cognition.

5 Li and Bratt (2004) cite Hiltz et al (1997), who define an Asynchronous Learning Network (ALN) as "a teaching and learning environment located within a Computer-Mediated Communication (CMC) system designed for anytime/anyplace use through computer networks".

Andrews and Haythornthwaite (2007) provide a useful framework for thinking about the fields and practices of education involving technology. They draw a continuum between online, distributed e-learning; traditional, face-to-face teaching; and placing blended learning in the middle. They put e-learning as a support for more conventional types of learning towards the end of the spectrum, at which they position conventional learning. By the latter, they mean "non-electronically mediated learning, fully offline, requiring no Internet access, online communication or online resource delivery"; a situation they describe as unimaginable for higher education. Most studies position themselves at some point on this continuum, within defined contextual parameters, (for example, an undergraduate computer science class), and concerned with particular tools (e.g. the use of PDAs or mobile phones). Few look at the ways in which a range of ICT is incorporated by students when learning with their peers in real-life contexts and constantly shifting along Andrews and Haythornthwaite's (2007) continuum.

Czerniewicz and Brown (2005) highlight the surprisingly scant evidence of the useful leverage of ICT for communicative purposes in teaching and learning objectives. They write that,

> although we know that ICTs offer unprecedented opportunities for additional and different kinds of communication, there is very little evidence of such use for teaching and learning purposes. This is despite the fact that learning itself requires dialogue, engagement and communication; and despite the fact that ICTs are used extensively for communicative purposes outside the educational context (p.16).

In the 1990s, most research on collaboration and ICT is in line with Crook's definition as "localised interaction within a small group working at a computer" (1999, pg. 109-110). Interestingly, Mercer and Wegerif (1999) note that,

> one of the spin-off effects of computers in early education has been the growth of interest among developmental psychologists in collaborative learning... The scarcity of computers in schools almost demanded that children were organised to work at them in small groups... computers made pupil interaction visible to researchers and, perhaps, suggested an attractively bounded situation in which students of cognitive development might study the topic of productive peer interaction. Thus, ways of using new educational technology brought a social psychological phenomenon into focus (p.103).

Since 1999, there have been a number of technological (and resulting sociological) developments which extend Crook's work. The convergence of technologies to date leaves Crook's exclusive focus on computers redundant; today, there are mobile phones with more computing power than the PCs of just a few years ago. Similarly, the rise in synchronous text and voice interactions through both computers and mobile phones means that learners are now communicating synchronously, while geographically apart.

Increasingly, researchers are shifting focus from one-to-one interactions between students and machines (Anderson et al, 2000) to the wider contextual factors at play. Salomon (1993, p.12) notes that systems of distributed cognition consist of an individual, his or her peers, teachers, and socioculturally formed cognitive tools. However, most of these studies focus on a specific tool or application. Examples include: Chan, Frydenberg and Lee's (2007) study of students in two countries collaborating with one another to create Skypecasts[6]; the interventions deploying wireless devices studied by Roschelle (2003); and the use of PDAs during field trips as an alternative to conventional paper-based workshops in an Ecotourism course at the Tshwane University of Technology (de Crom and de Jager, 2005). Although there are many studies on the use of specific modern ICT -- from PDAs (e.g. Wishart, McFarlane and Ramsden, 2005) to mobile phones (e.g. Scanlon, Jones and Waycott, 2005) -- few consider the role of low-tech, more ubiquitous tools in learning environments (e.g. textbooks and calculators).

Today, ICT provides numerous opportunities for peer-to-peer learning, as it enables communication between peers; co-ordination of peer-to-peer learning activities; collaboration in group projects; and the accessing, creating and re-working of content. New ICT – most

6 An audio podcast recorded over Skype

notably, web 2.0 technology [7]- offers increased opportunities for a range of collaborative learning activities. Asynchronous (enabled by email, email lists or group emails, blogs[8], wikis[9], social networking software[10] and SMS[11]) and synchronous (via instant messaging (IM) / chatting[12], Voice over Internet Protocol[13] [VoIP] online collaborative documents, conferencing and online learning environments) means of communicating, sharing information and collaborating have catapulted the field far beyond its early beginnings - the unit of analysis being a small group of people working around one computer.

Most research on learning and ICT in higher education focuses on instructional and system design, or learning outcomes in particular courses where the use of ICT has been prescribed. Lehtinen et al (no date) note that studies on ICT-enabled peer-to-peer learning that find positive effects are more likely to be published than those that show "negative or no significant effects" (p.34). There are many studies looking at interaction between students in an organised online learning intervention (e.g. Hiltz, Coppolla, Rotter and Toroff, 1999) and between students and lecturers (e.g. Markett, Sanchez, Weber and Tangney, 2005) or institutions (e.g. Nonyongo, Mabusela and Monene, 2005). Almost every study on the role of ICT in higher education focuses on interventions where ICT is introduced by course designers or coordinators. Very little is concerned with the role of ICT in learning as it occurs through the initiative of and self-adoption by students themselves. In many of the studies, students' use of ICT is incentivised, and often the students are already interested in and have experience and skills in using ICT as the courses studied are often in a related field, such as computer science. For example, in Haythornthwaite's (2001) study, where most students regularly responded to discussion questions posted on a Webboard, synchronous and asynchronous participation were each worth 10% of their grade for computer science.

Much of the literature on peer-to-peer learning and ICT also distinguishes between types of learning.

ICT and cooperative peer-to-peer learning

Wong, Chan, Chou, Heh and Tung (2003) coin the term "networked peer-based cooperative learning" to describe students helping one another to solve problems via a computer network. Haythornthwaite (2006) looks at student's use of ICT for working with peers, and talks about coordination as a low-level form of collaboration – where students divide the work into pieces, or pass pieces on from one to another in an assembly line mode. For Haythornthwaite, real collaboration involves "joint work on tasks, creation of shared definitions, pooling and sharing of knowledge, and creation of emergent outcomes." She writes that, "no single hand is visible in the final product" (p.12).

7 "A term describing changing trends in the use of World Wide Web technology and web design that aims to enhance creativity, information sharing, collaboration and functionality of the web. Web 2.0 concepts have led to the development and evolution of web-based communities and hosted services, such as social-networking sites, video sharing sites, wikis, blogs, and folksonomies" (Wikipedia, 2008).

8 "A type of website, usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video. Entries are commonly displayed in reverse-chronological order" (Wikipedia, 2009).

9 "A website that uses wiki software, allowing the easy creation and editing of any number of interlinked Web pages, using a simplified markup language or a WYSIWYG text editor, within the browser. Wikis are often used to create collaborative websites, to power community websites, and for note taking" (Wikipedia, 2009).

10 "A social network service focuses on building online communities of people who share interests and/or activities, or who are interested in exploring the interests and activities of others. Most social network services are web based and provide a variety of ways for users to interact, such as e-mail and instant messaging services" (Wikipedia, 2009).

11 "Short Message Service (SMS) is a communication service … allowing the interchange of short text messages between mobile telephone devices" (Wikipedia, 2009).

12 "Instant messaging (IM) is a form of real-time communication between two or more people based on typed text. The text is conveyed via devices connected over a network such as the Internet" (Wikipedia, 2009).

13 "Voice over Internet Protocol (VoIP) is a general term for a family of transmission technologies for delivery of voice communications over IP networks such as the Internet or other packet-switched networks. Other terms frequently encountered and synonymous with VoIP are IP telephony, Internet telephony, voice over broadband (VoBB), broadband telephony, and broadband phone" (Wikipedia, 2009).

ICT and collaborative peer-to-peer learning

The term "computer supported collaborative learning" (CSCL) was first used in 1989 by O'Malley and Scanlon, and picked up by Koschmann as an important area of focus in 1996 (Resta and Laferriere, 2007). The field looks at the use of technology to enhance learning and includes both synchronous and asynchronous communication between students who are in the same class, on the same campus, or in different countries around the world.

Citing Harasim, Hiltz, Teles and Turnoff (1995), Resta and Lafrerriere (2007, p.66) define online collaborative learning as "a learning process where two or more people work together to create meaning, explore a topic, or improve skills". Haythornthwaite (2006), in her discussion of research on collaborative learning, writes about collaboration as learning and knowledge creation, group learning, development and maintenance processes, computer-mediated communication, and the presentation of these issues in online learning environments. She maintains that "new knowledge can be built from the pooling of ideas and information, and actively testing these against the ideas of others" (p. 10). She cites Garrison, who states, "the goal of collaboration is to create a community of enquiry where students are fully engaged in collaboratively constructing meaningful and worthwhile knowledge" (p.10). According to Hiltz (1999), collaborative learning is something that happens when teachers tell students to collaborate in class.

Many studies on ICT-enabled collaborative learning focus on process or technology design. For example, Lundin and Magusson's (2003) study on collaborative learning between mobile knowledge workers aims to find relevant issues for design within the environment, "rather than to give a complete understanding of an environment (p.276)." Lehtinen et al (no date) posit that ICT offers education a wide variety of mediating tools for collaboration, and they review a number of applications and systems developed for educational purposes. They note that despite the "hundreds of papers" on CSCL, few report well-controlled experiments which enable the comparison between the use of CSCL in classrooms and collaborative learning environments that do not involve ICT. They cite Hiltz and Turoff's (1993) findings that users' social connectivity notably increased with the use of ICT, a strong tendency toward more equal participation and increased requests for and sharing of opinions. They also refer to Orlikowski's (1992) finding that culture and capacity to understand and use ICT impact on the degree to which it affects peoples' use of ICT to collaborate.

Citing Becta (2004), Barker, Krull and Mallinson (2004, p.3) point to evidence that the use of wireless technologies can increase collaborative learning and communication "because of the mobility and capacity of the devices". They highlight Stead's (2004) research which found that "learners engaged the most with the learning they could do together", and Zurita et al's (2004) findings that "wireless technologies solve the weaknesses of coordination, communication, organisation, negotiation, interactivity and mobility encountered in collaborative learning". In their review of social networks in students' learning experiences, Liccardi, Ounnas, Pau, Massey, Kinnunen, Lewthwaite, Midy and Sarkar (2007) write that blogs, wikis and online documentation are "gaining popularity and pedagogic credence as part of the learning process, as is the evolution of associated collaborative communities" (p. 225).

Saljo (1999, p.159) concludes a chapter about his research on collaborative learning with computers by saying that "working at the computer ... does not automatically produce learning and understanding. There is no mysterious flow of conceptual knowledge from the screen to the learner." However, he notes that,

> the technology provides opportunities for manipulating models and concepts in a manner that might be conducive to learning, provided that students are involved in conversations with competent partners who can assist in articulating the general conceptual issues involved in what is presented ... a sociocultural interpretation of this would be that learning is in the coordination between language and experience.

He explains that technology increases the range and nature of experiences for learning complex and abstract subject matter. He notes that the interactive nature of ICT can support

reasoning by "amplifying the nature and boundaries of scientific models of objects and events". However, he asserts that "the creation of knowledge is essentially a matter of learning to argue and no technology will ever replace the need for learners to participate in ongoing conversations with partners... it can only support it."

ICT and peer-to-peer tutoring
As with the two types of peer-to-peer learning discussed above, most studies looking at the use of ICT for peer-to-peer tutoring study the prescribed use of a specific application. For example, Anderson, Cheyne, Foot, Howe, Low and Tolmie (2000) studied undergraduate psychology students' participation in computer-supported methodology tutorials to structure discussion of the design of their honours dissertations. A sample of the discussions was videotaped and the discussions analysed. Their written assignments were blind marked and compared to a sample of similar assignments from the previous year. The researchers found that the computer-supported tutorials led to better quality written work.

In another study of a particular application, Wong et al (2003) tested the value of the Reciprocal Tutoring System (RTS), which comprises three "computational cognitive tools" which facilitate reciprocal tutoring of programming code on the network. They found that peer-based learning supported by cognitive tools is "a practical and attractive alternative to intelligent tutoring systems", but that the type of tutor preferred by learners depends on the latter's "cognitive, communicative and emotional needs in the tutorial context" (p.416).

2.4 Methodologies employed in related studies

Studies on peer-to-peer learning and the use of ICT employ a range of methodologies - from ethnography to network analysis. Mercer and Wegerif (1999) categorise the research in the late 1990s as either experimental studies where subjects engage in problem solving activities, or observational studies of the interactions of children in classrooms, where interpretive methods are used to describe and explain the processes observed.

In later studies, self-reported data is often collected via questionnaires and/or interviews with students and educators in addition to observations and recordings of the phenomenon taking place. For example, Anderson et al (2000) analysed videotaped dialogue discussions of peers working together using computer software. They also analysed individual logs of activities and reactions completed at the end of each tutorial (where students rated the helpfulness of the session and usability of the software), and had the students complete questionnaires once all the tutorials had been completed. The researchers compared the grades of the students' written work with that of the previous cohort of students who had not participated in computer-assisted tutorials.

The literature is filled with case studies. For example, in their paper which provides an Activity Theory perspective on the use of technology in Higher Education, Issroff and Scanlon (2002) describe two: the use of ICT in teaching a course on science communication to Masters students studying by distance, and the role of a website in a conventional undergraduate History course. Both cases focus on the role of ICT within specific courses as prescribed by the course coordinators. The data collection techniques used in the study are not explicated in detail, and are loosely referred to as "questionnaires, assessment material and conference contributions".

Lehtinen et al (no date) note that many studies on the use of ICT for collaborative learning are short-term experiments with small sample sizes. Besides broad studies looking at ICT access and/or use by students (e.g. Czerniewicz and Brown, 2005, 2008), a comprehensive review of the literature did not yield any surveys or studies using large data sets.

The levels of analysis vary widely across studies, and range from group or classroom processes using analytical frameworks such as activity theory or systems theory, to peer-to-peer interactions explored via interaction analysis and small group processes (Resta and Laferriere,

2007). Most researchers looking at collaborative and/or cooperative learning look at the instructional use of small groups of students working and learning together. Much of the research is thus focused on peer-to-peer learning that has been prescribed, rather than that which has spontaneously or organically developed and occurs as a result of students' initiative, rather than that of the teacher, lecturer or researcher.

2.5 Theoretical underpinnings of related studies

Peer-to-peer learning researchers adopt a wide range of theoretical perspectives. A list provided by Resta and Laferriere (2007, p.67) includes constructivist epistemology (Piaget, date), anchored instruction (Bransford, Sherwood, Hasselbring, Kinzer and Williams, 1990), cognitive apprenticeship (Brown, Collins and Duguid, 1989), cognitive flexibility theory (Spiro, Coulson, Feltovich and Resnick, 1996), group cognition (Stahl, 2006), knowledge building (Bereiter and Scardamalia, 1993), learning communities (Brown, 1997) and situated cognition (Lave and Wenger, 1991).

Some studies adopt a fusion of theoretical approaches. For example, Berge and Fjuk's (2006) study of online meetings in a net-based course on introductory object-oriented programming focuses on learners' use of online meetings to construct and maintain a community of practice, which stems from Wenger's (1998) social learning theory. The researchers then use activity theory to analyse the content of these meetings in order to shift focus iteratively between individuals' actions and the context in which they were carried out.

Wong et al (2003) adopt a similar approach. They conclude the discussion of their study on understanding virtual communities' activity and learning by noting that evaluations need to consider their social context, given goal and "evolutionary aspects", as well as the activity. They stress that, "it is necessary to concurrently take into account the process of participation (communication and action) and the process of reification (use and production of intermediary objects)." They acknowledge the limitations to what they describe as "a mere sketch for the development of a consistent theoretical framework", and note that a consistent framework should enable "a better definition of the characteristics and the diversity of virtual communities, as well as the relationship between socialisation and the learning they enable; an enhanced description of the processes that lead to learning; and a finer discrimination of the various types of learning" (p.485).

Hardman (2008, p. 44) cites a long list of researchers that have used Activity Theory "in a bid to understand the complex interaction that takes place in human-computer interaction" (Bannon and Bødker, 1991; Kaptelinin, Kuutti and Bannon, 1995; Kuutti, 1996; Bellamy, 1997; Kaptelinin, 1997; Russell, 2002; Kaptelinin and Nardi, 2006). She explains that AT enables researchers to explain how a change in one part of an activity system effects change in another. Dobson, LeBlanc and Burgoyne (2004) note that AT provides a descriptive language for interrogating activity systems into which tools are introduced, and Issrof and Scanlon (2002) concur. They cite Nardi's claim that AT "is a powerful clarifying and descriptive tool rather than a strongly predictive theory" (Nardi 1996, p.7). In their conclusion, Isroff and Scanlon (2002, p.83) identify a "key result" of the use of AT in their study as "to highlight the problematic features of the learning and teaching setting".

Laurillard (2001, cited by Resta and Larfrierre, 2007) points to the multiple factors at play in face-to-face and online learning environments, including pedagogical strategies, context, interaction with peers and instructor, and assessment. She notes the usefulness of systemic models for situating technology use within a broader context and highlights Engeström's (1987) activity theory framework for assessing activity change within a technology-supported learning community "by analysing role shifts, emerging rules and routines, and new learning and knowledge-building artefacts" (p.68).

2.6 Foci of related studies

The preceding sections have described the very different aspects and levels of peer-to-peer learning studied. Many studies seeking to unpack the role of ICT in learning do not focus on the type of interaction between students (i.e. cooperation, collaboration or tutoring), but instead on, for example, the network of a community of users of a specific application for learning. The key foci of related studies identified in the literature on ICT and peer-to-peer learning are (i) Informal and formal learning; (ii) the community of students; (iii) Multiple tools and mobile learning in context.

Informal and formal learning
Czerniewicz and Brown (2005b, p.9) found that ICT "take-up does not appear to be driven by lecturer requirements within courses only, but also seems to occur as students use computers as part of their own learning activities." They ask the question, "What drives students to use ICTs independently for their own learning?"

Again, in later research, Czerniewicz and Brown (2008) found that

> students used computers for learning even when they were not asked to do so, and they used computers informally. This was particularly evident in the case of communicative media where 55% of staff asked students to use communicative media as part of their courses, yet 75% of students reported using communicative media regularly for their learning, indicating that they were widely engaging in ICTs for non-classroom and informal learning activities.

There is little literature, as yet, about undergraduate students' informal peer-to-peer learning and the role of technology. In his literature review of informal learning outside school, Sefton-Green (2006) outlines various understandings of informal learning. He notes that the term is sometimes used to describe the location of learning (in-school is formal, while out-of-school is informal) or the purpose (i.e. some researchers view learning for leisure as informal, while that for examinations as formal). However, he points out that both formally organised / prescribed learning and accidental / spontaneous / non-curriculum-related learning occurs in both formal and non-formal spaces.

Vavoula (2004, cited by Scanlon et al, 2005) suggests,

> informal learning could be defined as a process of learning that occurs autonomously and casually without being tied to highly directive curricula or instruction. She presents a typology of learning based on the presence of, and control over, the goals and the process of learning. In intentional formal learning, the goals and the process of learning are explicitly defined by a teacher or by an institution. In intentional, informal learning, the goals and the process are explicitly defined by the learner. In unintentional, informal learning, the goals of learning are not specified in advance, and there is no prescribed learning process, but they can develop 'on the fly' as a learning occasion arises (p. 6).

According to Mercer and Wegerif (1999, p.104), the central challenge for educational practice is "the successful creation of continuities between pupils' existing concerns and new ones that we are asking them to reason about together in classrooms". They write that "once we start from accepting that the learner already has available a repertoire of discursive resources, our attention can become focused on how to bridge that gap between the playful and the schooled deployment of these resources." Generally, they are interested in "what can motivate pupils into collaborative forms of engagement with the new species of problem that schools define for them."

This study is concerned with learning focused on the academic goals prescribed by interviewees' university course curricula. There is no limit to the contexts in which learning between peers takes place for this purpose, as formal tutorials that occur as part of the course timetable, as well as informal conversations occurring off campus or virtually, are explored.

The community of students

Some studies focus on the community of people learning as peers as well as the different types of group composition and dynamics. Liccardi et al (2007) writes:

> There are many types of group that define different types of collaboration between individuals... The most formal types of group are teams where individuals collaborate to deliver a specific and well-defined task... Less formal types of group are determined as communities that demonstrate higher group cohesion and shared social values (p. 226).

The social network of learners is a focus for many studies on learning among peers. Liccardi et al (2007, p.226) write about informal groups of people who share a way of working together to accomplish an activity as "communities of knowledge". Lave and Wenger (1998) write about "communities of practice", which they define as groups of people with a common interest in a subject, who collaborate to share ideas or find solutions.

In their paper entitled "Understanding and Analysing Activity and Learning in Virtual Communities", Henri and Pudelko (2003) use Wenger's (1998) social learning theory as the basis for exploring "the principal components of the social context of the emergence and evolution of virtual communities". Wong et al (2003, p.476) list three principal components of the social context of the activity of virtual communities: the community's goal; the process by which the group was formed; and the "temporal evolution of both the goals and the methods of group creation". Using the dynamic and interdependent relationship between the strength of the social bond and the group's intentionality as a framework, they identify four principal types of communities along a "dialectic continuum": community of interest; goal-oriented community of interest; learners' community; and community of practice. The authors describe the communities' goal-oriented activities and strategies to understand "the process of negotiation of meaning at the base of the learning" and unpack the learning processes in terms of participation and reification.

Liccardi et al (2007, p.227) write that the factors differentiating these types of community "reside in the level of formality and contract value". They write that, for example, "Communities of Commitment" have low formality and contract value, unlike "Communities of Practice". They explain that the degree to which and frequency with which a community has to deliver concrete results influences the type of community that it becomes.

Andrews and Haythornthwaite (2007) point to both the computer network and the social network that sustain learning efforts in asynchronous learning networks (ALN). They write that, "More than anytime, anywhere input, it is anytime, anywhere access to a community where conventions and common interests reside and where individuals pull together to define the way their community will work." Liccardi et al (2007, p. 228) note that communities can also be defined upon the basis of their virtuality. They write that, "A virtual community is one that has some form of computer system facilitating the communication between the members as a central element to its definition". They note that in addition to social networks, "intentional networks" or "networks of practice" are another common form of community which is an informal collection of collaborators selected to accomplish a specific task. They maintain that this grouping "differs from teams since it is informal, has a shorter temporal duration, and low group cohesion. The members are not required to be familiar with each other as long as they can cooperate to deliver the task."

According to Wong et al (2003), members of a goal-oriented community of interest are "expert individuals, recruited for their competence or their experience, who will share the knowledge and approaches related to their respective spheres of speciality". Their "learners community" is a group of learners who communicate with one another, but "also with adults representing communities external to the institution, geographically and professionally" (p.481).

One of Tuomi's (2007) ten theses on the future of learning and education is that informal social learning will become the key to competence development. She writes that the members of 'virtual' communities support one another "in an extraordinarily effective way": As more-able

or experienced peers are typically people who have recently been in the learners' position, they can best ensure that their support meets learners' needs. "In Vygotsky's terms", she writes, "the peers are optimal guides through the zone of proximal development." Furthermore, she notes the incentive for learners to show "a genuine intent of learning" in order to garner their peers' best support: "the learners have to put substantial effort in the learning process if they want to advance in the community". She states,

> Active learners can flexibly mobilise substantial amounts of social capital to speed up their competence development. As the community recruits more novices and as they become old-timers and gurus, the total accumulated learning capacity of the community increases. Informal communities of learning can therefore produce a learning dynamic that, in economic terms, has positive returns. The community may become a 'common pool' learning resource that, in contrast to traditional economic resources, increases its value the more it is used (p.248).

Engeström (2007, p.336) argues convincingly that "a problem with the emphasis on networks is that it easily begins to overlook what is done together. Connections and collaborations themselves may be beneficial but they do not guarantee that the object of joint activity is transformed in a productive way". Although the learning communities of which interviewees are part are investigated in this study, the focus is on the productive activity of learning together. Hence theories focusing on the community or network of students are not an integral part of this study's theoretical framework.

Multiple tools and mobile learning in context

Traxler and Kukulska-Hulme (2005) note that the field of mobile learning is proliferated with pilots and trials testing mobile technologies in a variety of contexts. Roschelle (2003, p.262) points out that the network in which students and teachers participate via mobile devices is overlaid in the same space in which face-to-face interaction occurs. She writes that, "two distinct kinds of participation are occurring at the same time and in the same space: the normal participation in the classroom discussion (for example) and the new informatic participation among connected devices". Scanlon et al (2005) note that discussion about mobile learning necessarily leads to a consideration of informal learning, as much of the former occurs outside of educational settings (e.g. Vavoula, 2004).

Some of the recent work on mobile learning (Sharples et al, 2007) has shifted focus from learner-tool interaction to the mobility of learners and the range of interactions and contexts in which learning occurs. Beetham and Sharpe (2007, p.23) write, "Now that peer-to-peer learning is facilitated in a powerful way, on a global scale, through new social networking tools such as blogs, wikis, social bookmarking[14] and folksonomy[15], we see how learning can be socially situated in a way never previously possible" (Beetham and Sharpe, 2007, p. 23).

In order to explore the nature and development of group activities, the way in which multiple types of interactions are accomplished through the variety of communicative media and how this combines to create the collaborative environment, Haythornthwaite adopts what she terms a "multiplex approach". She presents a case study of the multiple work-related and social interactions and the use of multiple media among a class of distance learners. The study shows how these multiple interactions support group and subgroup activities, how they build the social network infrastructure that underpins group interaction, and how this develops over time. Her study provides a revealing view of group interactions and the role of computer-mediated communication.

Discussion

Haythornthwaite (2001) points out that while studies on the use of computers for collaboration

14 "Social bookmarking is a method for Internet users to store, organize, search, and manage bookmarks of web pages on the Internet with the help of metadata, typically in the form of tags that collectively and/or collaboratively become a folksonomy" (Wikipedia, 2009).

15 "A folksonomy is a system of classification derived from the practice and method of collaboratively creating and managing tags to annotate and categorize content; this practice is also known as collaborative tagging, social classification, social indexing, and social tagging" (Wikipedia, 2009).

tend to separate learning from, for example, work, community, and leisure, people learn from one another when working together, playing together or providing emotional support to one another. She notes moreover that these exchanges occur via multiple media and through both technology-facilitated and face-to-face exchanges. She maintains that it is thus important to assess the many types of exchanges that support the group as well as the various media they utilise. Few studies consider learning and the ways in which ICTs impact upon it within the wider context of learners' lives. However, the growing body of research on mobile, or m-learning, is taking wide steps outwards for a wider-angle view which is discussed below.

This study draws heavily on the work of both Sharples et al (2007) and Laurillard (2002, 2008) – both of whom have recently published book chapters on mobile learning. Sharples defines mobile learning as "the processes of coming to know through conversations across multiple contexts among people and personal interactive technologies" (p.225). Laurillard (2008) identifies the need to better characterise the critical factors that distinguish it from other forms of learning.

Laurillard (2008, p.156) emphasises "the nature of the physical environment in which the learner is placed, and hence the 'digitally-facilitated site-specific' learning experience that... was not possible with a desktop and landline." Citing Sharples et al (2007), she notes affective forms of motivation, such as "control, ownership, learning-in-context and continuity between contexts" as properties of mobile learning "that might make learning easier and more effective" (p.157).

Tuomi (2007) asserts that it is only when integrated into specific social practices that insights and technologies become real. She maintains that it is only when an idea or technology begins to have practical implications for a specific community of users that its interpretation becomes fixed, and that a specific technical artefact can have multiple meanings if several communities use the same artefact in their practices. She describes this phenomenon using a simile and writes that, "A specific implementation of technological functionality is like a word that can look the same but mean different things in different languages" (p.241). Referencing Engeström (1996), Tuomi notes, "If innovation is understood as change in social practices, one might implement education using activity theory, where learning in educational institutions can be embedded in more extended social learning processes" (p.242).

2.7 Conclusion

For the purposes of this study, Sharples et al's (2007) definition of mobile learning is used to define peer-to-peer learning: "the processes of coming to know through conversations across multiple contexts among [peers] and personal interactive technologies". The multiple contexts within which peer-to-peer learning occurs in this study include learning within formal learning environments such as classrooms, lecture theatres and computer labs, and informal learning environments such as homes and rooms in residences on university campuses. In terms of the focus of this "coming to know", this study is concerned with the support that students provide one another in order to meet the requirements of their academic endeavours.

Chapter 3

Theoretical framework

3.1 Introduction

Many academics in education bemoan the lack of strong theoretical bases for the study of pedagogy – from those concerned with what happens in classrooms (Ensor and Hoadley, 2004) to those looking at the role of ICT in education (Reddy, Ankiewicz and de Swardt, 2005). Czerniewicz and Brown (2005) note that local research on education and ICT tends to be under-theorised, but note that some researchers are at least beginning to interrogate some of the assumptions about the perceived benefits of ICTs for South African students.

This study is motivated by an interest in the ways in which people learn with one another and the role that ICT plays in this process in both formal and informal contexts. The study thus needs a framework that enables the analysis of peer-to-peer learning activities in different contexts, and aids exploration of the varying roles of ICT in each.

In seeking to understand how Fort Hare University students learn together, and the role that ICT plays in these interactions, this study sought a strong theoretical foundation. The research questions warrant a theory that attends to both social and contextual factors, and as they reach across and between disciplines, the requisite theoretical framework for this study needs to map the interface between the key concerns of peer-to-peer learning, and the role that ICT may or may not play in peer-to-peer learning.

This chapter outlines the theoretical framework for this dissertation. The first section positions the search for an appropriate theoretical framework within the broad area of Education and ICT. The next provides a brief overview of the study's underpinning theory of learning. Cultural Historical Activity Theory (CHAT), or Activity Theory (AT), which situates this learning in context, is outlined in the section that follows. Sharples et al's (2007) theory of mobile learning, which is essentially a development of third generation activity theory, is presented as the key theory used in this study, and described in detail. Finally, the contribution of Laurillard's (2002) work on the role of ICT in teaching-learning processes, and Czerniewicz and Brown's (2005, 2005b, 2008, 2008b) development thereof, is outlined as the work of these theorists is used to operationalise some of the high-level concepts in Sharples et al's (2007) model.

3.2 The search for an appropriate theoretical framework

While the framework needs to enable the analysis of the role of ICT, its theoretical lens should not focus onto ICT so sharply that it blurs insight into peer interaction, as the latter is the key research question. Too often, the precedence of ICT in theories seeking to describe or explain its role in education obfuscates that about which we are really concerned: learning. While it cannot be denied that ICT enables new ways of accessing, creating and sharing information and knowledge, much of the literature on ICT in education espouses an ideology of new, unique and ground-breaking educational practices to the extent that it fails to build upon the rich history of educational theory, which reflects a variety of technological advancements -- from number systems to the printing press.

Concluding her overview of peer-to-peer learning in educational history, Wagner (1990) states, "One can readily agree with an old German proverb, 'what is new is seldom true; what is true is seldom new'." She points out that "sometimes 'new' ideas in education are actually 'old' ideas in new guises" (p.39). The speed of technological innovation puts theories based upon assumptions about the characteristics, features, uses and applications of ICT to bed very quickly. Theories bound to ideas about what ICT *is* make the even relatively recent publications

in which they appear seem dated. A theoretical approach to the study of ICT that can accommodate all types of technology and ICT - from early mapmaking techniques of lines drawn in the sand to today's GIS and cartography software, and whatever tool or technology we may use in the future - would overcome this common shortcoming and ensure an analytical tool with the requisite historical breadth and depth. In order to fully answer the question of how students learn together, the framework should accommodate the analysis of the roles that other tools in addition to ICT (such as pens, textbooks and calculators) play in learning.

Much research, as well as policy[16], on Education and ICT often embodies a pro-technology substantivist approach, where technology is seen as the driver of change. A Castellian (1999, 2000), almost deterministic or evangelistic view of the power of technology for education and development has created a lot of hype and, unfortunately, not nearly as much substance. Dutton and Loader (2002, p. 18) maintain that many advocates of the information society "have uncritically accepted the assumptions underpinning this new paradigm. It has become almost an ideology rather than a theory that merits continual challenge and refinement through empirical research and reflection".

A more instrumentalist approach is needed (Feenberg, 2003), for it is important to note that it is not the technology per se that is transforming the ways in which we work, learn and play, but rather the ways in which it is designed, re-worked and upgraded in accordance with and in response to the ways in which it is used and desired to be used. ICT doesn't create the information society or solve problems by itself – it can only effect these changes through the ways in which it is used, and the motives and capacity of those using it.

There is no doubt that ICT - and the digital literacies its effective use requires, enables, and promotes - has the potential to transform education (and in many cases is doing so already[17]). However, to view this phenomenon in a linear fashion could in some instances verge on technological determinism. There is a danger that the potential that ICT holds for extending and transforming pedagogic practices leads practitioners and policymakers to focus on the technology rather than the more important fundamentals. Clegg et al (2003) make the case for a Vygotskian approach, and write that attention needs to be re-focused away from technology "back to the core relations between students and teachers and the conditions in which they find themselves". What is needed is a theory that enables the analysis of learning interactions in context.

This study focuses on *how* students learn together and the role that ICT plays in this process. The focus is thus neither on the students nor the technology, but the ways in which the interaction between the two impact upon learning. The study needs to be based upon solid theoretical principles about learning. It should elucidate viewpoints to the ways in which students learn together, the contexts in which this occurs, and the various tools employed. The search for an appropriate theoretical framework for this study thus begins with a theory of intra and interpersonal psychology and the role of tools in learning.

Vygotsky's approach, with its emphasis on the dialectical relationship between social interaction and contextual influences, enables the analysis of learning in all dynamic contexts. His basic claim was that "in the development of each child one can distinguish two lines: the line of natural development, that is, the processes of growth and maturation; and the line of cultural development, or the mastering of various cultural means, or instruments (De Veer and Valsiner, 1991, p.223)." Vygotksy's work on learning with others in context is relevant to this study as it provides a lens through which to consider the tools and processes that enable or

16 See for example, the South African Department of Education's (2006) White Paper on E-Education.

17 Leach and Moon present four case studies of teacher education practice in different contexts (South Africa, Albania, Paraguay and Northern Ireland). Each of the projects has harnessed the opportunities presented by modern ICT, the networked world and current understandings of the ways in which people learn, to support teachers in disadvantaged contexts. This is congruent with Carnoy and Castell's (1999) important point about the need for enhanced capacity to deal with the information and knowledge economy. By reorganising teachers' ways of working (Castells and Carnoy, 1999), and enabling them to join and develop new networks, these projects help teachers to harness educational resources and contacts to improve their teaching practices.

inhibit peer-to-peer learning.

3.3 Sociocultural learning theory

Roschelle (2003, p.260) maintains, "Pedagogical applications are often led down the wrong road by complex views of technology and simplistic views of social practices". He calls for research that interrogates the interface between enabling technology and social practices of learning. He notes that "a clearer identification of the separate roles of technology-based communication and non-technology-based interpersonal communication" is needed (p.270).

The previous section highlighted the requisite characteristics for the theoretical framework for this study. The argument was made for a framework that enables the analysis of learning interactions between peers using various tools in various (both formal and informal) contexts.

This section presents a sociocultural approach to learning and introduces Vygotsky's work. Specifically, it details his description of mediation and explicates his Zone of Proximal Development (ZPD). It outlines how his theory was developed into activity theory (AT), a framework that has been developed into a second and third generation, by Leontiev and Engeström respectively. The development of third generation activity theory into what Sharples et al. term "a theory of mobile learning" is then posited as the appropriate theoretical framework for this study. Finally, Laurillard's conversational framework and Czerniewicz and Brown's (2005) development thereof is presented as a means for unpacking and operationalising two key aspects of Sharples et al's (2007) theory.

3.3.1 Culture

> *Everything that is cultural is social. Culture is the product of social life and human social activity. That is why just by raising the question of the cultural development of behaviour we are directly introducing the social plane of development* (Vygotsky 1981, *cited by Wertsch and Tulviste, 1996).*

"Vygotsky's strikingly original ideas still offer new and unfulfilled promise for both Psychology and Education, [75] years after his death" (John-Steiner and Sourberman, 1978, p.122), and his cultural-historical learning theory best encapsulates what it is meant by "learning" for the purposes of this study. His work fuses two key issues with which theorists were grappling in the 1930s: teaching and cognitive development, and the conclusion he draws from his research is that "teaching enables a series of developmental processes that undergo their own development" (Van De Veer and Valsiner, 1991, p.331).

Vygotsky believed that learning is located in the interplay between culture and individuals. He believed that learning occurs through interpersonal interaction, and that individuals transform through tasks undertaken in collectives (Vygotsky, 1986, cited by Saljo, 1999, p.149). Vygotsky termed the process through which this transformation takes place "mediation", and the 'space' in which this occurs "the zone of proximal development". These concepts are detailed below.

Wertsch, 1991 (cited by Hardman, 2005a) explains that, "through mediated action, culture becomes internalised as a set of regulatory processes". By placing culture at the centre of his theory, Vygotksy ensured the consistent relevance of his theory of learning. Although his work pre-dates the advent of modern ICT, it provides a lens for exploring mediating artefacts and their role in cultural and social human activity. For Vygotsky, "there can be no universal schema that adequately represents the dynamic relation between internal and external aspects of development" because the historical conditions "which determine to a large extent the opportunities for human experience are constantly changing" (John-Steiner and Sourberman, 1978, p.125). The historical breadth and depth of Vygotksy's theory of learning easily encompasses the study of peer-to-peer learning and the role of ICT, as it allows for the dynamic modes and contexts in which peer-to-peer interactions take place as well as the variety of ever-changing tools employed.

3.3.2 Mediaton

> *All higher functions originate as actual relations between human individuals... The internalisation of socially rooted and historically developed activities is the distinguishing feature of human psychology* (Vygotsky, 1978, p.57).

For Vygotsky, learning occurs through structured assistance, or mediation, between a student and a teacher or more-able peer. A central premise of mediation is that a student can accomplish more with assistance than on their own (Hardman, 2008, p49). He explains,

> Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment, and in cooperation with his peers. Once these processes are internalised, they become part of the child's independent developmental achievement (Vygotsky, 1978, p.90).

The dual focus on interpersonal interactions and intra psychological development is key for a study seeking to explore how students learn together.

3.3.2.1 Mediating artefacts

> *A sociocultural view builds on the assumption that learning has to do with how people appropriate and master tools for thinking and acting that exist in a given culture or society* (Wertsch, 1998).

In his research and writing, Vygotksy depicts the process of learning as mediation through the use of tools and signs. He believed that "the internalisation of culturally produced sign systems brings about behavioural transformations and forms the bridge between early and later forms of individual development" (Cole and Scribner, 1978, p.7). He writes, "The use of signs leads humans to a specific structure of behaviour that breaks away from biological development and creates new forms of a culturally-based psychological process" (Vygotsky, 1978, p.40).

Vygotsky (1978) "use[s] the term higher psychological function, or higher behaviour, as referring to the combination of the tool and sign in psychological activity." For Vygotsky, "the learning is not only inside the person, but in his or her ability to use a particular set of tools in productive ways and for particular purposes" (Saljo, 1999, p.147).

3.3.2.2 The Zone of Proximal Development

The Zone of Proximal Development, or ZPD, is the term Vygotsky gives to the 'space' within which mediation takes place. He defines the ZPD as "the distance between the actual developmental levels as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers..." Vygotksy's inclusion of collaboration between peers alongside and at the same level as guidance from an adult is useful for this study. According to Vygotsky, "What is in the ZPD today will be the actual developmental level tomorrow -- that is, what a child can do with assistance today she will be able to do by herself tomorrow" (1978, p.86-87). The ZPD thus accounts for the movement of learners' cultural development from the interpsychological (between people) to the intrapsychological plane (inside the learner).

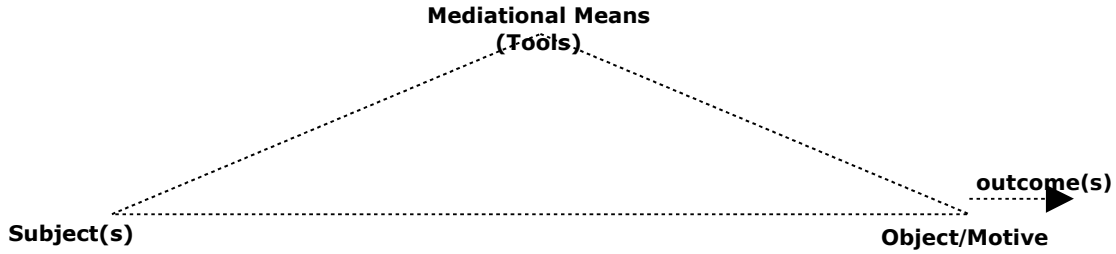


Figure 2: Vygotsky's triadic representation of learning (Daniels, 2001)

In his ZPD, Vygotsky provides a framework for exploring the different functional relations between subject, tool and object (Roth and Lee, 2007, citing Suchman, 2000). Figure 2 graphically represents how a human interacts with the world by means of cultural artefacts; the world is never approached directly in the course of the development of higher cognitive functions but is always mediated (Wertsch, 1998). That is, "the natural relationships represented at the base of the triangle become subsumed under cultural relationships represented at the apex of the triangle" (Hardman, 2008, p.49). The subject, an individual or group, uses mediational means in order to act on the object of the activity. The object is that 'thing' that is acted on by the subject using mediational means. The object can be ideal (such as a concept) or material (a block of wood carved into a statue) (Hardman, 2007).

Given its focus on interpersonal learning, the use of signs and tools, and the positioning of these things in context through the lens of culture, Vygotsky's theory holds promise as an appropriate lens through which to explore peer-to-peer learning. However, section 3.2 identified the need for a framework that enables the analysis of learning in context, and Vygotsky's work does not meet this need explicitly. Although his work refers to the sociocultural context in which mediation takes place, he does not provide directive on key elements of this context or how to study them. This leads us to Cultural Historical Activity Theory, which develops Vygotksy's work and situates mediation across the ZPD with tools in context.

3.4 Inter(action) in context

Vygotsky's theories of mediation and the ZPD underpin what has come to be referred to as first-generation Activity Theory. Its development by other theorists into second and then third generation theories was prompted by two needs: to clarify the distinction between individual and collective activity and to situate learning within a wider context.

Luria and Leont'ev, two of Vygotsky's collaborators, further developed his work to incorporate the societal, cultural, and historical dimensions of wider context. Their work has come to be termed second generation AT, and develops Vygotsky's activity mediated in relative isolation to that "acting in concert with diverse, changeable artifacts" (Roth and Lee, 2007). "The relationship between action (goal) and activity (motive) is dialectical, for actions constitute activities, but activities motivate particular action sequences" (Roth and Lee, 2007).

The distinction between individual action and collective activity as implied, but not articulated in Vygotsky's theory, was elaborated by Leontiev whose famous example of the "primeval collective hunt" clarified the distinction between individual action and collective activity (1981) and placed division of labour firmly within his definition of activity (Hardman, 2007, p. 114). Leontiev (1978; 1981) built on Vygotsky's original thesis, extending his theory to develop the notion of hierarchical levels of human functioning, accounting for societal, cultural and historical dimensions of human activity (Roth, 2004; Roth and Lee, 2007). While Leontiev did indeed extend Vygotsky's theory, his endeavours differed in significant ways from Vygotsky's

project. This is especially so in relation to the notion of semiotic mediation. For Leontiev, semiotic mediation is not central to development; practical labour activity rather than signs and symbols mediate cognitive development (Kozulin, 2003). Leontiev's hierarchical model of functioning conceives of activity as driven by the object, while individual actions are directed at goals.

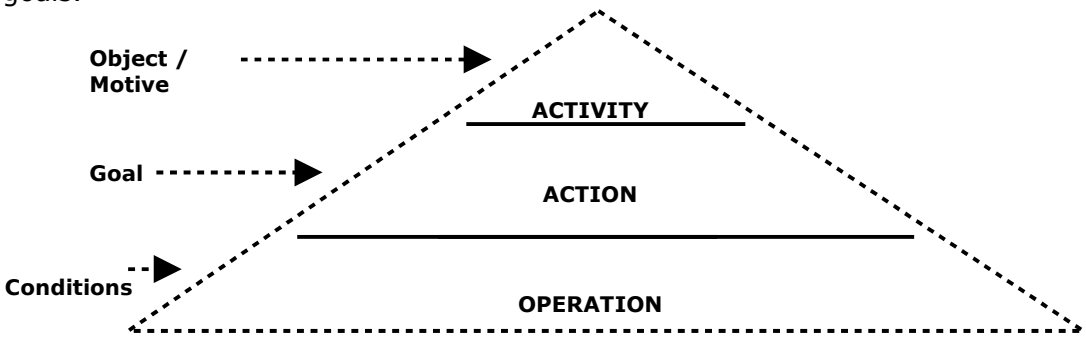


Figure 3: Second generation Activity Theory. Source: Daniels (2001, p.87)

While Vygotsky's learning theory points the way towards an understanding of learning as distributed, it does not develop an analytical framework capable of situating learning within a wider context, accounting for the collective and dynamic nature of activities (Engeström, 1987; Lim and Chai, 2004, Hardman, 2007). And although Leontiev's theory accounts for hierarchical levels of human functioning, it does not go far enough to situate human functioning in context for the present study. It also fails to illustrate how individual actions are transformed into shared, collective objects through interactions with community members or how division of labour impacts on individual actions in a collective activity. This is where Engeström's (1987) conceptualisation of an activity system (see figure 4) as the basic unit of analysis serves as a useful tool for situating activity in context (Hardman, 2008).

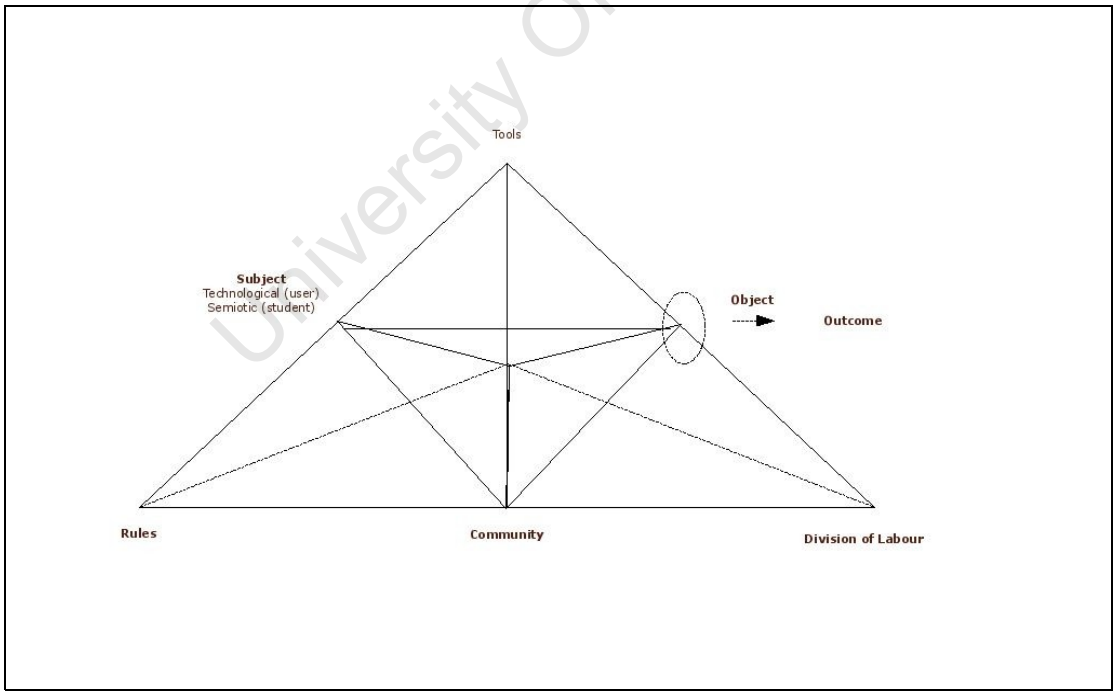


Figure 4: Third generation Activity Theory

In figure 4, the subject acts on an object using mediating artifacts. Rules constrain and afford action, and community members stand in hierarchical and/or vertical relations to each other. The expanded model accounts for the learning and development of both the individual and collective activity system, and depicts the nodes of collectively mediated activity. It illustrates

the construction and distribution of mediation among the tools, rules and procedures, and divisions of labour. The subject's actions towards the object are mediated by the artefacts and the community. The subject's relation to the community is mediated by rules, and the relation between the community and the object is mediated by division of labour (Berge and Fjuk, 2006, p.16). The individuals engaged in activity interact with and are affected (both directly and indirectly) by the activity's community of stakeholders.

Third generation AT provides a lens through which to analyse the actions produced within the activity system[18]. Engeström writes, "Activity is achieved through constant negotiation, orchestration and struggle between different goals and perspectives of its participants. The object and motive of a collective activity are something like a constantly evolving mosaic, a pattern that is never fully completed" (1999, cited by Daniels, 2001). The misfits between nodes, activities, or developmental phases within an activity are referred to as 'contradictions'. Contradictions "manifest themselves as problems, ruptures, breakdowns, clashes... and are seen as sources of development; activities are virtually always in the process of working through contradictions" (Kuutti, 1996). Berge and Fjuk (2006, citing Kuutti, 1996) point out that contradictions can appear "within the elements of the activity system, between them, between different activities or between different developmental phases of an activity" (p.16).

These contradictions drive constant change in activity systems, which are "constantly working through contradictions within and between their elements" (Engestrom, 1987, cited by Russell, 2002). A change in one aspect of the activity system may conflict with another, and these conflicts can, for example, cause incongruence between people and/or tools. The emphasis on contradictions within activity systems as the driving force of change and development is the theoretical basis for the consideration of issues going forward (Daniels, 2001). The identification and analysis of contradictions within and between activity systems yields interesting perspectives on which aspects of the system hinder or obfuscate progress towards the object, and highlights where different objects in interacting activity systems are at cross-purposes.

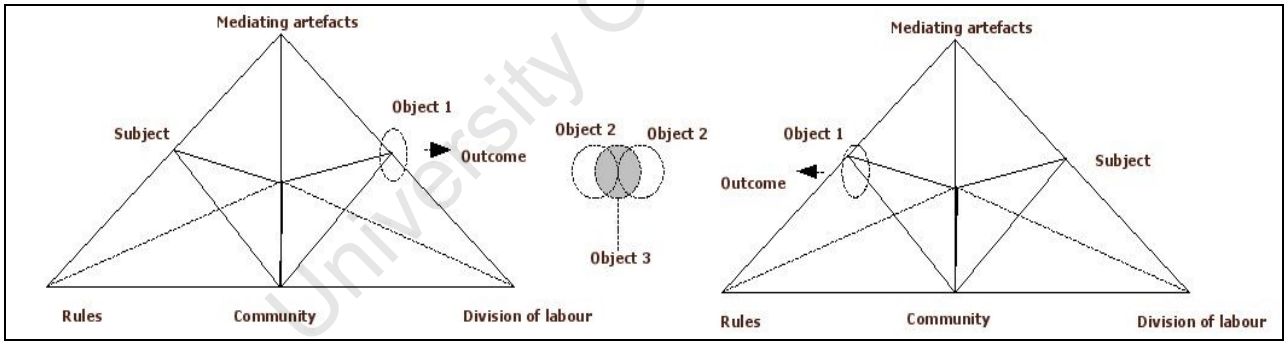


Figure 5: Interacting activity systems (adapted from Engeström, 1999)

Figure 5 illustrates two activity systems interacting with each other, acting on a shared object, which in turn shifts and changes over time. Research conducted within the paradigm of third-generation AT prioritises the role of "dialogue, multiple perspectives, and issues of power when dealing with interacting activity systems as networks" (Roth and Lee, 2007: p.200). Engeström and Miettinen (1999) describe the networks between activity systems when explaining how they impact upon and affect one another. They write that mediating artefacts can be "combined, used and transformed in novel ways in local joint activity" (p.11).

Third generation activity theory has been used for a number of studies researching the use of ICT in education. Sharples, Taylor and Vavoula's recent (2007) development of third generation AT into their "Theory of Mobile Learning" provides interesting and useful additions to the model that have much to offer this study. The criteria they identify for the theoretical framework to

18 Engeström's expansive learning cycle, which is more suited for intervention-based research, is not used in this study.

study mobile learning range from accounting for mobility of learners in both informal and formal learning, theorising learning as a constructive and social process, and analysing learning as "a personal and situated activity mediated by technology". The authors posit third generation AT as the theory that meets these criteria, but they adapt the framework to show the dialectical relationship between technology and semiotics. They also re-name the cultural factors in Engeström's model to terms that are relevant to both educational theorists and technology designers. These changes are explained in detail in the section below, which posits Sharples et al's (2007) theoretical development of AT as a good fit for this study.

3.4 Technology and semiotics

In their study on the use of mobile phones for learning during a field trip to an art gallery, Sharples et al (2007) further develop third generation Activity Theory into what they term "a theory of mobile learning" in order to explore the role of technology in the activity.

The authors place mobility of learning as the object of analysis in order to better understand "how knowledge and skills can be transferred across contexts" (2007, p.223) and posit that a theory of learning should encompass both formal (e.g. in lecture theatres) and informal (e.g. in a room in residence) contexts.

Other requisite attributes of a theory of mobile learning listed by the authors include understanding how people engage with their surroundings and the tools in them for learning; a view of learning as "an active process of building knowledge and skills through practice within a supportive group or community"; and taking into account the ubiquity of personal (e.g. mobile phones) and shared (e.g. computers in a lab on campus) technology. Again, these requirements apply for this study.

The definition the authors propose for mobile learning is "the process of coming to know through conversations across multiple contexts among people and personal interactive technologies". Embedded within this definition are the two key concerns of this study: how people learn together, and the role of technology. Sharples et al write that the focus of their investigation is "not the learner, nor their technology, but the communicative interaction between these to advance knowing".

Although Sharples et al (2007) position their theory of learning as that of the "mobile age", which is often construed through the ubiquity of mobile technologies such as mobile phones and laptops, they emphasise that "even learners within a school will move from room to room and shift from topic to topic". They do not separate mobile activity from other forms of educational activity, and maintain that their theory instead "illuminates existing practices of learning from a new angle" (p.222).

Sharples et al's search for a theory with the criteria discussed above ends with Engeström's third generation AT. The situation of activity in context, while allowing for the re-creating of that context through continual interaction, ensures the applicability of third generation AT to mobile learning as defined by Sharples et al (2007). The authors (citing Lonsdale et al, 2003), posit that "the common ground of learning is continually shifting as we move from one location to another, gain new resources, or enter new conversations" (p. 230).

Sharples et al (2007) achieve their theoretical development of Engeström's model by superimposing layers onto the AT triangle. This enables the exploration of the role of ICT in activity both as part of mediated activity in context and separately, and is hence the most appropriate theoretical framework through which to respond to both key research questions in this study.

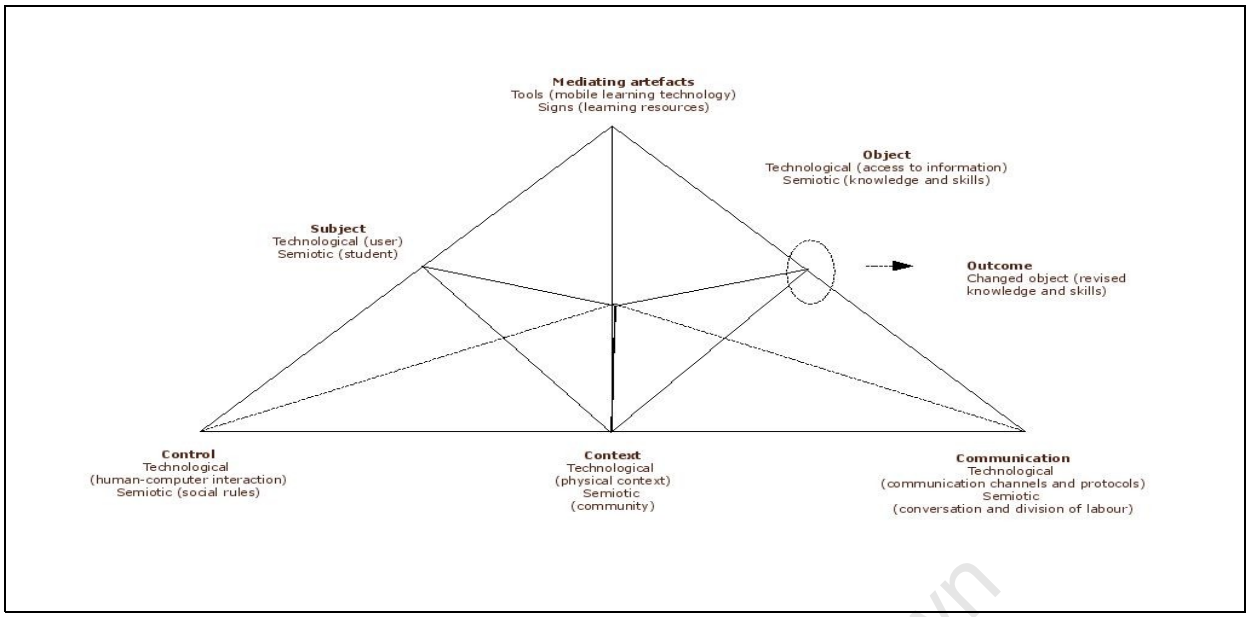


Figure 6 : A framework for analysing mobile learning (adapted from Sharples et al, 2007)

The authors describe the activity system of mobile learning "in a way that problematises the dialectical relationship between learning and technology", by separating two perspectives, or layers, of tool-mediated activity. Acknowledging the influence of Vygotsky's work, they write, "The semiotic layer describes learning as a semiotic system in which the learners' object-oriented actions (i.e. actions to promote an objective) are mediated by cultural tools and signs." The technological layer, they explain,

> shows learning as an engagement with technology, in which tools such as computers and mobile phones function as interactive agents in the process of coming to know, creating a human-technology system to communicate, to mediate agreements between learners (as with spreadsheets, tables and concept maps) and to aid recall and reflection (as with web logs and online discussion lists) (p.233).

Usefully, Sharples et al's (2007) semiotic and technological layers can be prised apart, to enable investigation of one or other aspect of the activity, or they can be superimposed (figure 6) "to examine the holistic system of learning as interaction between people and technology" (p.233).

Articulating the difference between tools and signs, Vygotsky writes:

> The tool's function is to serve as the conductor of human influence on the object of activity; it is *externally* oriented; it must lead to changes in objects. It is a means by which human external activity is aimed at mastering, and triumphing, over nature. The sign, on the other hand, changes nothing in the object of a psychological operation. It is a means of internal activity aimed at mastering oneself; the sign is *internally* oriented. These activities are so different from each other that the nature of the means they use cannot be the same in both cases (Vygotsky, 1978, p.55).

Sharples et al (2007) help with operationalising this distinction for each node of the Activity Theory triangle. Their framework enables the analysis of the role of technology not only as a mediating artefact, but also in the ways it affects the rules, context and communication within an activity.

The authors emphasise that they are neither proposing the separation nor fusion of the semiotic and technological layers. Rather, they propose that these two layers are dynamically and dialectically connected, and can be moved together and apart in order to propel the analysis of mobile learning. Sharples et al. remind their readers that activity systems are

constantly in flux, "with movement between the nodes of a given system, and between one activity system and another". They write, "This dialectical shaping can emerge at various nodes in the activity framework and provides the process that binds its two levels together" (p.236).

Sharples et al (2007) re-name the cultural factors in Engeström's triangle (Rules, Community and Division of Labour) as Context, Control and Communication. They suggest that these updated and clearer terms update the model from its Marxist lexicon of cultural-historical materialism. The authors suggest that these terms increase the accessibility and relevance of the model to both educational theorists and technology designers. In order to prevent alternative interpretations of these terms, the authors attempt to clarify their meaning (summarised below). For the purposes of this study, the terms prove useful for operationalising the high-level third generation AT concepts and developing categories for data analysis.

Control
The authors explain that control of learning may sit with one person, such as the teacher or tutor, or it may be distributed among a group of learners, and can also pass between learners and technology. They write, "The technological benefit derives from the way in which learning is delivered: whether the learners can access materials when convenient, and whether they can control the pace and style of interaction" (issues of human-computer interaction design) (p.234). The semiotic aspects of control play out in the social rules and conventions of the context in which the activity occurs, and in peoples' attitudes to, for example, the technology, or the informal rules about the ways in which a group likes to work and learn.

Context
At the semiotic layer, the authors' understanding of context encompasses "the multiple communities of actors (both people and interactive technology) who interact around shared objectives, mutual knowledge, orientations to study, styles and strategies of learning". In illustrating how context plays out at the technological layer, they refer to the debate "about whether context can be isolated and modelled in a computational system, or whether it is an emergent and integral property of interaction" (p.235).

Communication
Sharples et al (2007, p.235) maintain that the dialectical relationship between the technological and semiotic layers is easiest to see in relation to communication, as access to new ICT leads learners to "adapt their communication and learning activities accordingly". Where communication channels and protocols are analysed at the technological layer of the model, the semiotic layer is concerned with conversation and division of labour.

In their chapter on "Learning for the Mobile Age", Sharples et al discuss new forms of communication and conversation with the adoption of modern ICT. However, their description for the previously termed "division of labour" node in the model lacks the detail required to fill the gap between high-level concept and operationalised category. Laurillard's theory of Conversation details communication and learning activities and shows how they link with various ICT, which she categorises as "media forms". Laurillard's framework is introduced in the next section and detailed in the next chapter in which the analytical framework is outlined.

Nodes in the peer learning activity triangle
Each node in Sharples et al's (2007) triangle comprises a high-level theoretical concept that needs to be unpacked and broken down into categories that make up the analytical framework for the study. With the activity system as the unit of analysis for students' peer-to-peer learning, each node comprises a high-level concept from which categories for data analysis were developed.

Object
As Hardman (2008) explains, the object in an activity system is conceptualised as both material (the what) and the ideal (the why). According to Engeström, "the object is 'the raw material or problem space at which the activity is directed and which is moulded and

transformed into outcomes" (Centre for Activity Theory and Developmental Work Research, n.d, cited by Hardman, 2008).

Subject
In this dissertation, each interviewee is viewed as a "subject" in the peer-to-peer learning activities they describe. They act on the object in each of the activity systems in which they are part in order to achieve an outcome. Each subject's demographics, attitudes, experiences, opinions and viewpoints will impact upon the way in which they participate in activities. Following Engeström (1999b) and Hardman's (2005, 2008) precedence, demographic information and opinions (about, for example, issues related to peer learning and the use of ICT for learning) was collected from the interview and survey data.

Community / Context
The community comprises the group of individuals participating in the activity – in this case, the activity of peer-to-peer learning. In this study, these individuals are primarily the subject's peers with whom he or she studies. Additional members of the community include tutors paid by FHU, other students who are not part of the subject's study network, lecturers, other staff (such as librarians or lab administrators), and the subject's friends and family members.

The activity's physical contexts can include both on- and off-campus locations. Identifying the different contexts in which students' peer-to-peer learning activities play out helps to understand their dynamic nature. The role of ICT in these activities emerges as the context shifts between off- and online communication.

Mediating artefacts
Following Sharples et al (2007), mediating artefacts are identified as either semiotic or technological tools. The distinction broadly follows that made by Vygotsky between tools and signs. Semiotic mediating artefacts include both language and content substance (the information and knowledge that students aim to assimilate through learning), while technological mediating artefacts include the format of this content substance (e.g. online or printed content) as well as ICT and other tools that subjects use while participating in the activity.

The ICT used in the peer-to-peer learning activities identified in this study are categorised according to Laurillard's media forms (the reasons for and form of this approach are detailed below).

Rules / Control
By highlighting the explicit and implicit rules in an activity system, AT enables researchers to unpack the locus of control, which is imperative for understanding why activities play out in the ways they do (Hardman, 2008). Highlighting the norms and conventions informing study group etiquette and learning processes will engender a deeper understanding of how students learn together. Examining the environmental or contextual rules and norms, as well as the norms underpinning the use of various ICT, with endgender an understanding of human-computer[19] interaction in the activity.

Communication / Division of Labour
Investigating the qualities of conversations between participants in the activity, and the ways in which roles, responsibilities, workload, and power are distributed vertically and hierarchically tells us a great deal about how students learn together. Sharples et al's (2007) additional concern around communication channels and protocols at the technological layer of the activity assists in explicating the role of ICT in the activity.

Outcome
The subject and community in an activity act on the object and transform it into results,

19 The term human-computer interaction is used here in keeping with Sharples' (2007) general practice in the field, but also refers to the interaction between humans and ICTs in general.

outputs and/or achievements, which are termed outcomes. The outcomes of peer-to-peer learning might be, for example, better understanding, or a completed group assignment.

3.5 Shifting from theory to analysis: Mediated activity and the role of ICT

> *Central to our definition [of mobile learning] is that conversation is the driving process of learning* (Sharples et al, 2007, p.225)

Every theorist mentioned in this chapter, from Vygotsky to Sharples, writes about the importance of conversation in learning. John-Steiner and Souberman (1978, p.131) write that Vygotsky's view of learning as "a profoundly social process" leads him to emphasise dialogue, and the "varied roles that language plays in instruction and in mediated cognitive growth". Perhaps one of the biggest shifts in Sharples et al's (2007) development of third generation activity theory is the shift of division of labour to communication. In Sharples' (2007) version of the activity theory triangle, division of labour features alongside conversation as the key aspects of the semiotic layer of this important node in the AT triangle. Unfortunately, the authors do not explicate this shift in detail.

In this study, Laurillard's Conversational Framework (2008) and Czerniewicz and Brown's (2005) development thereof is presented as a means to operationalise "communication" and "conversation". Laurillard's Conversational Framework (1993, 2003, 2008) enables the exploration of the "teaching-learning process as a 'conversation" (2002, p.104) by mapping "the dialogic process" between 'teacher' and 'student'.

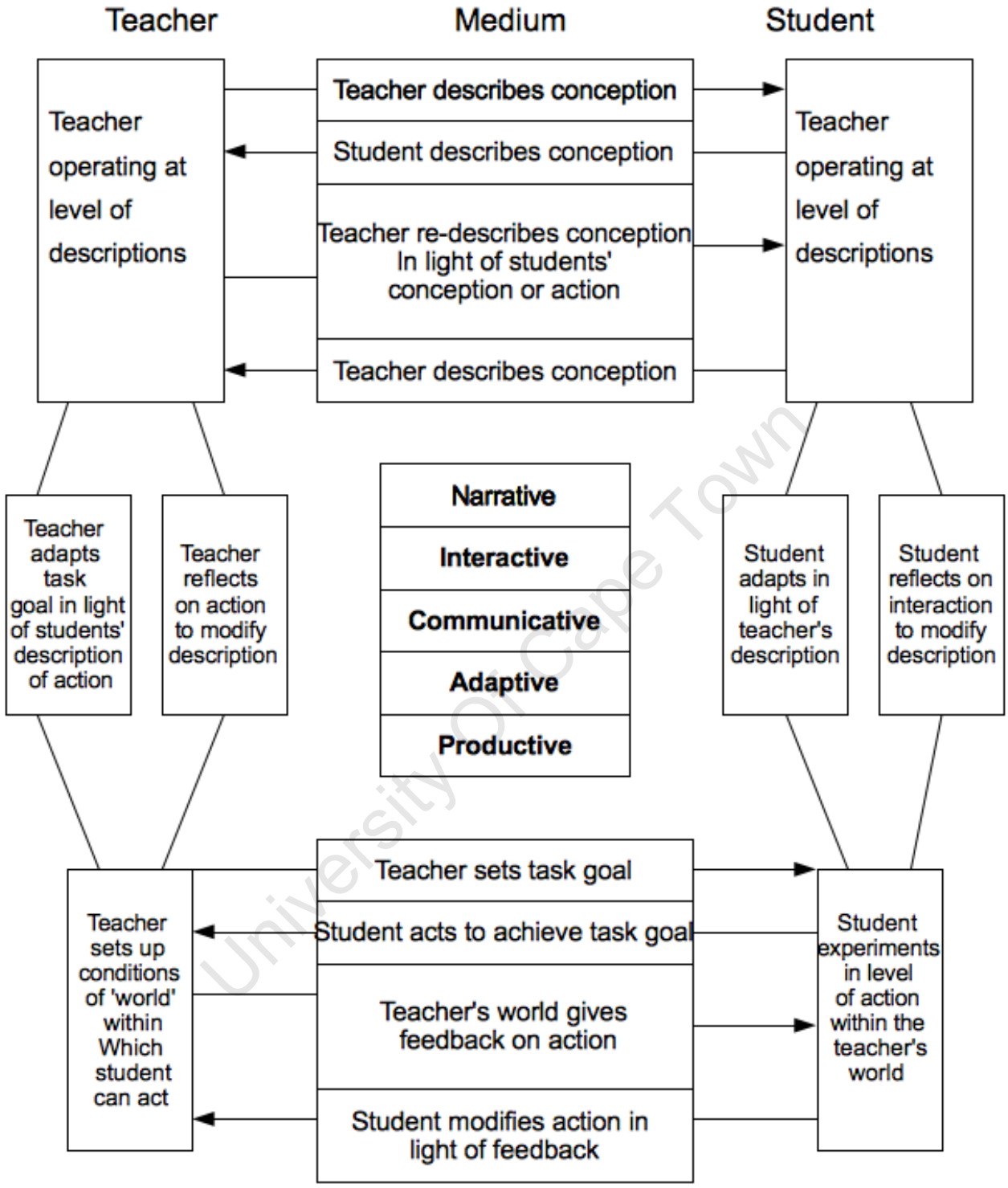


Figure 7: Laurillard's Conversational Framework

Laurillard (1993, 2003) writes about teaching and learning interactions as "events", and her framework links these with specific purposes as well as specific forms of technology (Czerniewicz and Brown, 2005). She sees her framework as "a way of capturing the essentially iterative, communication and goal-oriented actions with feedback that is necessary to complete the learning process".

Two aspects of Laurillard's Framework are helpful for this study: teaching and learning events and their related media forms. These are laid out in the table 2 below, which is from Czerniewicz and Brown's (2005c, 2008) development of Laurillard's Conversational Framework. In this study, these teaching and learning events and their related media forms are used in the analytical framework to operationalise two nodes of Sharples et al's (2007) triangle: mediating artefacts and communication.

In developing the analytical framework for their *Access and Use* survey, Czerniewicz and Brown (2005) clustered the key learning events from Laurillard's (2002) framework. Table 2 shows how they map teaching and learning events and actions to their related media forms.

Teaching and learning event	**Teaching action or strategy**	**Learning action or experience**	**Related media form**
acquisition	show, demonstrate, describe, explain	attending, apprehending, listening	narrative
discovery	create, setup, find or guide through discovery spaces and resources	investigating, exploring, browsing, searching	interactive
dialogue	setup, moderate, frame, lead, facilitate discussions	discussing, collaborating, reflecting, arguing, analysing, sharing	communicative
practice	model	experimenting, practicing, repeating, feedback	adaptive
creation	facilitate	articulating, experimenting, making, synthesising	productive

Table 2: Teaching and learning events and associated media forms (Czerniewicz and Brown, 2005)

Czerniewicz and Brown (2005c, 2008) found their analytical framework adapted from Laurillard (2002) useful for empirical analyses of the use of ICT for teaching and learning, as it enabled them to link and relate media types to learning and teaching interactions, and "move beyond a notion of use which measures functionality as a checklist of frequency to one which allows ICT use to be considered in relation to specific teaching and learning events" (p.44). Czerniewicz and Brown (2005, p.4) write that, "these events are not phased, linear or progressive; no one is better than any other. Rather, they are likely to occur in different configurations at different times as required. These events involve specific teaching strategies, roles or actions which interact with specific learning strategies, roles, actions and experiences."

(i) Mediating artefacts: Media forms
A key contribution from Laurillard (1993, 2003) and Czerniewicz and Brown's (2005) work is the categorisation of ICT forms. These categories (in the final column in table 2) are very useful for this study's secondary research question around the role of ICT in peer-to-peer learning. The table clearly illustrates how the framework explicitly links ICT or media forms to teaching and learning actions and "events", and these categories are useful for operationalising the mediating artefacts in Sharples et al's (2007) model.

(ii) Teaching and learning events: Communication / Division of Labour
Sharples et al's (2007) re-positioning of the division of labour node in the third generation AT triangle as communication is a useful first step towards operationalising these high-level concepts in developing an analytical framework. The authors further define the semiotic layer in of the communication node as "communication channels and protocols" and the

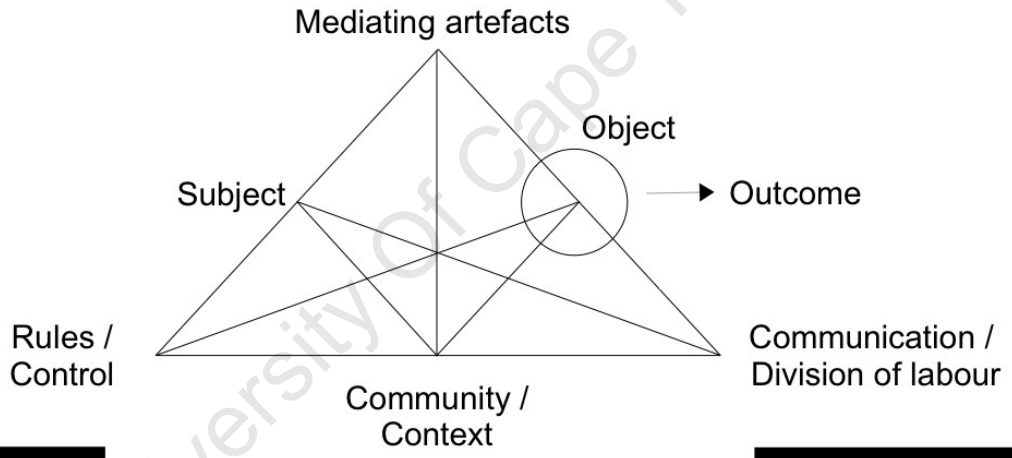
technological layer as “conversation and division of labour”. Again, these are useful pointers towards the categories that need to be developed for data analysis. However, these terms remain conceptually quite high-level, and Laurillard's (2003) teaching and learning events (acquisition, discovery, dialogue, practice and creation) are used to operationalise the concepts of communication and division of labour.

The ways in which Laurillard's (1993, 2003) work is used to operationalise these two nodes in Sharples' AT triangle for exploring peer-to-peer learning is further detailed in the next chapter, in which the analytical framework for this study is mapped. The diagram below depicts the theoretical framework and the ways in which the work from the authors discussed in this section fits together. In the following chapter, each node in this framework is described in more detail, with the categories that comprise the coding schedule illustrated as a series of tables.

Concepts drawn from Sharples et al's (2007) Framework for analysing mobile learning

Concepts drawn from Czerniewicz & Brown's (2005) development of Laurillard's (2002) Conversational Framework

Mediating artefacts	
Semiotic	Language
Technological	Narrative media
	Communicative media
	Productive media
	Adaptive media



Mediating artefacts	
Semiotic: Social rules	Study group rules and etiquette
	Peer learning processes
Technological: Human/ computer interaction	Environmental/ contextual rules and norms
	Norms for ICT use

Community / Context	
Semiotic: Community	Peers
	Educators
	Off-campus stakeholders
Technological: Physical context	On-campus stakeholders
	Off-campus locations

Communication / Division of labour	
Semiotic: Conversation and division of labour	Allocation and distribution of roles, responsibilities, workload and power
Technological: Communication channels and protocols	Acquisition
	Discovery
	Dialogue
	Revision
	Creation

3.6 Conclusion

While AT has been used in studies in a variety of contexts – from the workplace (Engeström, 1999b) and the classroom (Hardman, 2005a, 2005b, 2005c), to an after school computer literacy programme (Olivier, 2007) and studies in creativity (Daniels, 2005) – it has not yet been used for the study of university students' peer-to-peer learning[20].

The framework presented above appears to overcome three self-identified limitations to the framework used by Wong et al (2003), based on Wenger's (1998) social learning theory (discussed above). The nodes in the AT triangle with Sharples' two superimposed layers enable an in-depth exploration of the characteristics and diversity of the communities and the relationship between culture and learning. The framework's solid sociocultural learning theory foundation enables a deeper understanding of the processes of learning and mediation, while the further categorisation of communication roles and processes using Laurillard's conversational framework enables a "finer discrimination of the various types of learning" (Wong et al, 2003, p.485).

The wealth of theoretical work in the various approaches discussed in this chapter provides a solid foundation and most of the scaffolding for this study's analytical framework. The exploration of peer-to-peer learning activity in context is guided by Sharples et al's (2007) development of the technological and semiotic layers in Engeström's Activity Theory and the operationalisation of some of these high-level concepts with Laurillard's (1993, 2003) categorisation of learning and teaching actions and media forms. The ways in which the theoretical framework informs and guides the development of the analytical framework for this study are detailed in the following chapter.

20 An extensive review of the literature, using the search functions of google scholar and UCT's electronic journal database found nothing. However, it is possible that new work has been published since.

Chapter 4

Research methodology

4.1 Introduction

Peer-to-peer learning at South African universities is under-researched and under-documented[21]. The aim of this research is to provide an in-depth description of the ways in which some Fort Hare students are learning together and the role that ICT plays in this activity. Data was collected through two sources: survey questionnaires and in-depth semi-structured interviews. The surveys formed part of a nation-wide research study, entitled *Access and Use,* conducted by UCT's Centre for Educational Technology. The survey sought to explore the extent and nature of ICT use by university communities in South Africa. Early adopters of ICT for peer-to-peer learning were systematically identified from the survey data. The research processes, from sampling to data analysis, are described in this chapter which ends with a discussion of validity and ethics issues in the research design.

The data collected for this research is entirely self-reported by Fort Hare University students. While the reliance on self-reported data poses validity challenges, Laurillard (2002) argues that students' descriptions of phenomena comprise empirical data for discovering more about a phenomenon as opposed to testing an already articulated hypothesis[22]. Crook (1999, p.115), writing about his research on collaborative learning, explains that rather than purporting to tease apart psychological processes as isolated variables in controlled observations or experiments, what is under observation is "more of a system". This study aims to understand the phenomenon or system of peer-to-peer learning from the point of view of the students themselves[23], and this chapter outlines the methodology undertaken to do so.

4.2 Preparation and pilot

The research process began with an immersion into the *Access and Use* Survey data. The development of interview schedules was informed by the findings from the Survey, the literature of related empirical and theoretical studies. The schedule was then piloted with three students from universities in the Western Cape, prior to embarking on fieldwork in the Eastern Cape. The selection of pilot participants was, to the extent possible, in accordance with the demographics of the interviewees identified from the *Access and Use* sample: faculty, campus, qualification currently studying, current level of study, age, home language, gender and nationality, as well as whether or not they are the first person in their family to go to university (Czerniewicz and Brown, 2008b).

21 A comprehensive literature search using google scholar and UCT's electronic journal database yielded only that covered in the literature review.

22 "The methodology of phenomenography... derives its empirical base from discovery rather than hypothesis testing. It uses qualitative... data, and its output is categories of experience, rather than relational explanations... In being descriptive of how students experience learning, however, it provides an empirical base that can inform our approach to teaching" (Laurillard, 2002).

23 The presentation that got Vygotsky noticed in Moscow's experimental psychology scene in 1924 promoted interviewing as a method in pscyhological research. In it, he argued that subjects' introspectional accounts of their subjective experience could be studied as "objective reactions" (rather than reliable accounts of their subjective experience) (Van der Veer and Valsiner, 1991, p.41-42).

University	Gender	Age	Nationality	Home language	Course	Level	Occupation and highest educational level of breadwinner	First in family to attend university?
CPUT	F	20	South African	isiXhosa	Information Technology	3	Quality controller	Yes
UNISA	M	22	South African	isiXhosa	BAdmin (Human resources)	2	Administrator	Yes
UCT	M		South African	isiXhosa	BSc (Physics and Chemistry)	3	Self-employed	Yes

Table 3: Interviewees participating in pilot

Following the pilot, the interview schedule was improved through the clarification of questions, removal of redundant questions, and the addition of a few new questions. The process also provided an opportunity for the interviewer to experiment with both voice recording and note-taking data capture techniques, which led to adoption of the former.

Following the pilot, interviewees were identified through the systematic approach described below. They were then contacted, and interviews at the East London and Alice campuses were scheduled during August 2008.

4.3 Sampling and data collection

4.3.1 Survey data

Czerniewicz and Brown (2008), as part of their widespread study of access to and use of ICT at South African tertiary institutions, carried out a survey at Fort Hare University in 2007. Extensive questionnaires capturing both quantitative and qualitative data were administered to staff and students on the campus. A student was paid per completed questionnaire that he was able to collect, and he adopted a convenience sampling method.

375 observations were collected through the *Access and Use* survey at FHU (see survey schedule in appendix C). The *Access and Use* data describes the extent, and to some extent the nature, of students' use of ICT from their perspective. Due to the small sample size and lack of systematic sampling strategy, a weighting strategy for improving the data's representivity was sought. Stata, a software package for statistical analysis, was used in an effort to identify and then apply weights to variables existing in the University of Fort Hare's student population data.

The following demographic variables, collected in the final section of the *Access and Use* Survey were present in the FHU student population data:

- Faculty
- Campus
- Gender
- Age
- Country/Region

- Home language

FHU administrators described the information for level of study in the student population data as inaccurate, and it was thus not considered as a viable variable to weight.

Many of the 375 observations in the *Access and Use* data had missing information for the above variables. Fifteen of the observations had no data for these variables, 117 had data missing for one or more, and 18.9% had no information on age. The observations for which there was no information for these variables were dropped, and age was dropped as a potential variable for weighting.

The table below compares the two data sets according to some of the variables.

	Access and Use	**FHU Student population**
Gender: Female	53%	54%
Language: Other African	24%	11%
Language: isiXhosa	50%	74%
Language: Ndebele	7%	0%
Language: English	6%	9%
Language: Zulu	6%	1%
Country/Region: South Africa	61%	85%
Country/Region: SADC	24%	13%
Campus: East London	43%	36%
Campus: Alice	56%	61%
Campus: Bisho	0.6%	3%
Faculty: Education	9.5%	14%
Faculty: Law	10.3%	9%
Faculty: Management and Commerce	49%	28%
Faculty: Social Sciences	16%	16%
Faculty: Science and Agriculture	16%	18%

Table 4: Comparison of Access and Use Survey and FHU student database data sets

Of the 292 potential combinations of the five variables, there are no observations in the *Access and Use* data for 221. For many of the combinations requiring larger sample sizes, the sample population is too small. For example, isiXhosa-speaking South African female Social Science students in Alice comprise 11.13% of the student population, but are represented by only 3% of the sample. The isiXhosa-speaking South African male Social Science students make up 6.69% of the student population, yet unfortunately only 1% of the sample.

The small group of observations that would be required to represent large proportions of the population for each of the variables that could be weighted could exacerbate the reliability

problematic through the use of outliers of a part of a group to generalise. Given the sampling strategy and under-representivity of big groups, weighting would not improve the reliability or potential generalisability of the findings. Further statistical analysis or the generation of descriptive statistics was therefore not carried out, as findings would be misrepresentative of the Fort Hare University student population. However, the information gleaned through the survey was very useful for identifying early adopters and high-end users of ICT for peer-to-peer learning to be interviewed.

The interviews were also useful validity checks for the survey questionnaire, and suggest that piloting the questionnaire at FHU may have improved the tool's validity. For example, some respondents in the survey indicated that they "often" use a tool (e.g. VoIP, wikis and blogs) whereas it became evident during the interviews that they did not know what these applications are.

4.3.2 Sampling for interviews

An atypical, criterion non probability sampling method (Wellington and Szczerbinski, 2007) was used to identify interviewees from the pool of survey respondents. Cases outside of the norm were deliberately sought, according to the following criteria:

- Often communicate with other students by email, group email lists, IM, SMS or Mxit[24]
- Work with other students on online document (e.g. wiki)

Only respondents who had indicated their willingness to participate in follow-up study, and provided their contact details in their completed questionnaire schedules, were included in the original sample, which also sought to achieve a balance of genders.

The rationale behind this approach was to identify the early adopters[25] of ICT-enabled peer-to-peer learning strategies and tools, in order to better understand the factors that led to this practice, its patterns, and the ways in which it is experienced by the students. Tuomi (2007) notes that the key to innovation is the social adoption of new technological opportunities. She notes that the term "adoption" is misleading, and writes that "the processes that determine the fate of innovative opportunities are better described as user-centric innovation, knowledge creation and learning" (p.241).

Of the 34 students identified as potential interviewees (respondents who appeared to use ICT for peer-to-peer learning purposes, and had given permission to be contacted for follow-up study), fifteen were contactable, and interviews were scheduled with each of them. Four students were unable to make the interviews on the days that they had been scheduled; a total of eleven interviews were thus conducted. That saturation and replication of data was reached in the interviews is indicative of sampling adequacy, and ensures that sufficient data for key aspects of peer-to-peer learning and the role of ICT was obtained (Morse, 2002).

24 Mxit "(pronounced "mix it") is a free instant messaging software application developed in South Africa that runs on GPRS/3G mobile phones and on PCs. It allows the user to send and receive one-on-one text and multimedia messages to and from other users, as well as in general chat rooms" (Wikipedia, 2009).

25 The term "early adopters" was originally used by Bohlen, Beal and Roger (1957) in their sociological model of the technology adoption lifecycle. The researchers (who were tracking the purchase patterns of hybrid seed corn by farmers) called the first users of the product "innovators", followed by "early adopters". Early adopters (who are usually younger and more educated) tend to use new technology earlier than the "late majority" and the "laggards"

4.3.3 Interviewees' profiles

Of the eleven participants interviewed:

- 5 are female and 6 are male
- 6 are studying at the Alice campus and 5 are in East London
- The ages ranged from 20 to 30, with a mean of 22.7
- 8 are South African and 3 are Zimbabwean
- For 4 participants, their home language is isiXhosa, while 3 speak Zulu and 3 speak Shona. One participant lives in a bilingual home, where both isiZulu and isiXhosa are spoken.
- 2 were studying towards a BSc; 6 BCom, and 3 Bed
- The current level of study ranged from 2 to 5, with a mean of 2.4
- 9 of the participants are the first in their family to attend university
- All but one stayed in residence

	Campus	Gender	Age	Nationality	Home language	Course	Level	Occupation and highest educational level of breadwinner	First in family to attend university?
1	EL	F	24	Zimbabwean	Shona	BComm (Accounting)	4	History teacher; A level and teaching diploma	Yes
2	EL	M	25	Zimbabwean	Shona	BComm (Accounting)	5	Reverend: Currently studying a degree in Theology	Yes
3	Alice	M	30	South African	isiZulu	BEd (Science)	3	Unemployed: Diplomas	Yes
4	EL	M	20	South African	isiXhosa	BComm (Accounting)	2	SME partner: Grade 12	Yes
5	Alice	F	21	South African	isiXhosa	BSc (Chemistry)	2	Auditor: Commerce degree	No
6	Alice	M	25	South African	isiZulu	BEd	2	Self-employed: Primary	Yes
7	Alice	F	21	South African	isiXhosa	BComm (Accounting)	2	Shared responsibility: policeman and nurse: Degree	No
8	Alice	F	22	Zimbabwean	Shona	BSc (General)	3	Driver: Grade 12 and technical courses	Yes
9	EL	F	22	South African	isiXhosa	BComm (Accounting)	2	Unemployed: n/a	Yes
10	EL	M	20	South African	isiXhosa and isiZulu	BEd	2	Domestic worker: Grade 11	Yes
11	Alice	M	20	South African	isiZulu	Bcomm	2	Occasional informal employment; pensioner	Yes

Table 5: Interviewees' demographics

The 11 interviews took a total of 290 minutes, and ranged from 18 to 47 minutes in duration, with an average time of 26 minutes. They were audio recorded and transcribed.

4.4 Data analysis

Initial categories were drawn from the literature, beginning with the high-level concepts represented by each node and their semiotic / technological layers in Sharples et al's (2007) AT triangle. Following Hardman's (2008) approach, sub-categories were developed "inductively

and deductively in relation to the data" (p.98). Czerniewicz and Brown's (2005) development of Laurillard's (2002) work also informed the development of key sub-categories, as described below. Appendix B, which illustrates the analytical framework in a one-page diagram, is a useful reference to frame the discussion that follows.

4.4.1 Analytical framework

This study draws heavily on Hardman's (2007, 2008) approach of operationalising AT through developing categories for the analytical framework from high-level AT concepts. The superordinate categories for the analytical framework are the nodes in an activity system: subject, object, mediating artefacts, rules, context and division of labour. The semiotic and technological layers superimposed upon these nodes by Sharples et al (2007) comprise the sub-categories that frame the analysis. These sub-categories are then further broken down into categories in an iterative process whereby the key issues emerging from the data are interlaced with the theoretical framework. The categories developed for two AT nodes -- communication and mediating artefacts -- were informed by the teaching and learning events and associated media forms which Czerniewicz and Brown (2005) developed from Laurillard's (2002) work. Each category was assigned a unique code, and the interview data coded accordingly. This systematic operationalisation is outlined in appendix B and detailed below for each high-level AT concept.

Maxwell (1992) reminds us that developing "precise and uniform" criteria to demarcate the boundaries of categories is extremely difficult (and unlikely). He maintains that "ambiguity and fuzzy boundaries are the rule rather than the exception in categorisation" (p.285). In an effort to delineate the boundaries between categories developed for this analytical framework, each is as precise and explicit as possible, such that the process whereby data is assigned a unique code is as unambiguous as possible. Both the theoretical framework and the data informed this process, with the resulting analytical framework straddling the space between the theory and the activity that it is seeking to describe. (Bernstein terms this space the "discursive gap" (Ensor and Hoadley, 2004)).

We are reminded by Ensor and Hoadley (2004, p.13) that trustworthiness is ultimately a matter of rigour, and the establishment of clear criteria of worth". Chapter 3 details the background and development of the theoretical framework, and this section details the iterative development of the analytical framework, drawing on both theory and the data. The findings of the research can be challenged upon the basis of the analytical framework as, in the interests of transparency, the coding scheme is presented in its (very detailed) entirety (Ensor and Hoadley, 2004).

Objects

The process for mapping high-level concepts to the empirical data began with the identification of objects. The questions posed during the interviews sought to unpack students' learning activities. As students spoke about their learning, they described various motives and subject areas. In this study, the object refers to both the material and the ideal -- following Hardman (2008); it can be understood as both the 'what' and the 'why'. Thus, whenever students spoke about either what they were studying, or why, these were coded as O1 (what) and O2 (why).

Lim and Hang's approach (2003, cited by Hardman, 2008) to mapping the activity system of computer-based classrooms in Singapore helped to guide the identification of objects through the following questions:

- What is / are students' objectives when they engage in peer-to-peer learning?
- What are the implicit and explicit objects (beliefs) that they have about peer-to-peer learning?

- Do different students have different objectives?
- When do objectives shift, and why?

Bødker (1996, also cited by Hardman, 2008), looks for the focus of the activity in order to identify the object which, Hardman points out, enables the observation of shifts in the object. Another question thus helped to inform the identification of objects in the data:

- What are the foci of students' peer-to-peer learning activities?

Subject
As all data in this study is self-reported, the subjects in the activities investigated in this study are the eleven interviewees.

Mediating artefacts
Following Sharples et al's (2007) work, mediating artefacts were categorised as either semiotic or technological tools. Table 6 shows the three categories of language identified in the data: vernacular (many students spoke about communicating with their peers in their home languages); academic (many distinguished between the "complex" and "complicated" language used by their lecturers compared with their peers' simpler language) and accent (the different ways in which words are pronounced).

MEDIATING ARTEFACTS: SEMIOTIC TOOLS

Sub-category	Category	Description	Code	Empirical example
Language	Vernacular	Home language vs English	TL1	"...even using the language maybe... maybe sometimes I will ask using my mother tongue, and then it's easier to talk to colleagues, rather than your lecturers or your tutors, because they are using basically English" (Interviewee no.3).
	Academic	Complex versus "simpler" language	TL2	"...the complicated explanations that you may find from your lecturers".
	Accent	Unfamiliar pronounciations	TL3	"Some lecturers, I don't understand the way they pronounce names... I don't get what they're saying. I'm working very well with my peers... Everything they state is clear" (Interviewee no.4)

Table 6: Operationalisation of high-level AT concept: Mediating artefacts – semiotic tools

Laurillard (1994, p.22) maintains that "successful use of media depends on the learning context together with an understanding of how selected technologies work and under what conditions they appear to be effective". Her (2002) media forms (narrative, communicative, productive, interactive and adaptive media) provide a useful means with which to categorise the technological tools used by interviewees.

According to Laurillard's (2002) categorisation of media forms, narrative media "tell" or show the learner something, and are largely informative. This sub-category was further broken down into tools that either present or store information. Communicative media facilitate exchanges between people, and these were further distinguished as tools that enable either synchronous or asynchronous communication. Laurillard categorises tools that enable learners to create or produce something (a tangible output such as an essay or graph) as productive media, while those that respond to an action by a learner (e.g. a list of search results in response to a search term) are labelled interactive media. Adaptive media change according to learners'

actions and enable experimentation (for example, simulations and games).

MEDIATING ARTEFACTS: TECHNOLOGICAL TOOLS

Table 7: Operationalisation of high-level AT concept: Mediating artefacts – technological tools

Sub-category	Category	Description	Code	Empirical example: ICT-based tools	Empirical example: non-ICT-based tools
Narrative media	Content presenting tools (hardcopy and electronic)	Electronic information accessed online and hardcopy information accessed offline	TCF1	Electronic journals, eBooks, websites, online dictionaries	Textbooks, library books, journals, past exam papers, dictionaries etc.
	Local and offsite content storage tools	Hardware and software for storing and sharing content	TCS1	"flash disk", "I record lectures with my phone".	Files, notes, pens, pencils
Communicative media	Asynchronous communication tools	Software applications for communicating at different times	Tcom1	SMS, email	Notes in the margins of textbooks
	Synchronous communication tools	Software for simultaneous communication	Tcom2	Voice calls, IM/Mxit	Face-to-face conversation
Productive media	Office programmes, online collaboration tools, recording devices	Software programmes used to create content (e.g. essays, lecture notes, assignments, etc.)	TCC1	Examples include: Word processors, Spreadsheets, Presentation software	Writing with pen on paper; "notes on whiteboard"
Interactive media	Content searching and identification tools	Software that enables identification of and access to information / content	TCI1	Search engines and library database search engines ; "google"; social networking software; wikis; blogs	Perusing books on the shelves in libraries
Adaptive media	Tools for experimenting, practicing and providing feedback	Tools for experimenting, practicing and providing feedback	TA1	games	

Rules / Control

Prescriptions, directions, rules and norms playing out within activity systems signify the shifting loci of control in an activity. Sharples et al's (2007) use of the terms "social rules" and "human-computer interaction" to differentiate between the semiotic and technological layers of this node in the AT triangle was used as the basis for the development of these categories and codes. Categories for social rules emerged from the data, and were grouped as rules and etiquette (scheduling of sessions and the norms governing interactions with tutors and/or peers, as well as group development and composition) and peer learning processes (the pace at which content is covered and the order in which the learning operations play out).

RULES/CONTROL (semiotic layer): SOCIAL RULES

Sub-category	Category	Description	Code	Empirical example
Study group rules and ettiquete	Scheduling of sessions	Regularity of meetings; sessions held within course timetable or informally and independently from course schedule	SS	Some peer learning groups meet regularly throughout the semester (some as organised by the course schedule, while others are self-organising). Others meet only in the weeks or days before exams or tests.
	Tutor / tutee engagement	Norms and ways of being in formal tutoring sessions	ST	"With tutors, you get to interact with them on a one-to-one basis... they know your weaknesses as well. You relate to them, you're open to them. You have time to do practical questions..." (Interviewee no.2).
	Processes for joining / leaving the group	Group norms around joining and/or leaving the group	GN	"We don't have a stable number. Because some quit, and you get new ones. So I don't have a set number... 1, 2, 3, 4 .. But not above eight" (interviewee no.9).
Peer learning processes	Pace	Speed at which requisite content is covered	PP	"It takes too much time... you are maybe five, ne. And you are not the same. Some catch faster... yeah, some take time to understand. So when you are a group, you have to understand all of you" (Interviewee no.9).
	Ordering of process	Norms for flow of learning process, e.g. discussion, explanation, research, preparation, etc. while working with peers	PO	"We usually give each other tasks, ne. To maybe... we have a particular subject that we want to study. And then it has its own sections. And then maybe a particular person might go and study and check on that particular section. And then actually we will all go out and try to find information relative to the section that we will present to the colleagues, so that we can all have equal share of the information that we are studying" (Interviewee no. 3).

Table 8: Operationalisation of high-level AT concept: Rules / Control – Social rules

The superordinate category of human-computer interaction was sub-categorised into environmental / contextual rules and norms and norms for ICT use. Both FHU lab rules and factors effecting ICT access (availability, reliability and cost of equipment, electricity, Internet access) were found to be useful categories for the environmental and contextual rules. Interviewees' descriptions of the norms governing their use of ICT were categorised according to whether the norms interviewees referred to were around the use of ICT for social or learning purposes.

RULES/CONTROL (technological layer): HUMAN-COMPUTER INTERACTION

Sub-category	Category	Description	Code	Empirical example
Environmental / contextual rules and norms	Lab rules	UFH lab rules governing access to computers and the Internet, as well as certain sites or applications	RL	"Access to certain sites (e.g. facebook, vodacom4me) is available only at certain times in the day "and that's when people rush to the Internet thingy... it's packed then" (Interviewee no.2).
	ICT access	Availability and reliability of equipment, electricity, Internet access, cost	IA	Most interviewees referred to the instance where a few months prior to the interview there had been load shedding on campus for over a month.
Norms for ICT use	Social purposes	Norms governing the use of ICT – i.e. whether or not various applications are used exclusively for learning or social purposes, or both.	NS	"No-one will ever be interested to chat about academics. They'll just be interested in music, or movies... You know students, when they're chatting, they think it's break time, or just free time to do something else... not to work. Because they will try to get as far away from schoolwork as possible" (Interviewee no.1).
	Learning purposes		NL	"I don't use Mxit for academic purposes because I would need a bigger screen for chats and stuff."

Table 9: Operationalisation of high-level AT concept: Rules / Control – Human-computer interaction

Community / Context

The superordinate categories for this node of the activity system are "community" and "physical context" (Sharples et al, 2007). The members of the community that interviewees spoke about are their peers (they distinguished between those who were members of their study groups or partnerships and those who were not), educators (lecturers and tutors) and off-campus members of the activity (family and friends).

COMMUNITY/CONTEXT (semiotic layer): COMMUNITY

Sub-category	Category	Description	Code	Empirical example
Peers	Study group members	Students who are members of the interviewees' study group	GM	Typically, each interviewee had a core group of regular study partners. Some groups were more fluid than others, and the composition of the groups ranged from a study partnership between two peolple who had been studying together for two years, to the more widespread setup of a group of four to eight students who study together regularly.
	Other students	Other UFH students who are not part of interviewees' tutorials or informal study groups	CS	"...sometimes, we don't understand something.. all of us, we don't get it. So we have to try and get information from someone else... We usually go to other classmates... people that we know." (Interviewee no.5).
Educators	Lecturers	UFH lecturers for interviewees' subjects	CL	We resolve disagreements by finding "the information leader, like the lecturer to clarify... the lecturer or the tutor" (Interviewee no.6).
	Tutors	UFH tutors tutoring interviewees	COMT	
Off-campus members of the activity	Family and friends	Interviewees' family and friends	CF	"My sister helps me a lot" (interviewee no.7).

Table 10: Operationalisation of high-level AT concept: Community / Context -- Community

As evident in table 10, interviewees mentioned a number of on- and off-campus locations where they engage in peer-to-peer learning. Students referred to their homes (either their parents' homes or their own off-campus accommodation) when speaking about off-campus locations, while on-campus, peer-to-peer learning activities played out in lecture theatres / classrooms / auditoriums, residences, computer labs and the library.

COMMUNITY/CONTEXT (technological layer): PHYSICAL CONTEXT

Sub-category	Category	Description	Code
On-campus locations	Lecture theatres and classrooms on campus	Lecture theatres and classrooms on campus	PLT
	Rooms in residences	Rooms in residences	PR
	Computer labs	Computer labs on campus	PL
	Libraries	Libraries on campus	PLIB
Off-campus locations	Rooms in private residence	One of the interviewees lives off-campus	PH

Table 11: Operationalisation of high-level AT concept: Community / Context – Physical context

Communication / Division of Labour

Division of labour is both vertical and horizontal and refers to the negotiation of responsibilities, tasks and power relations within an activity (Hardman, 2007). Sharples et al (2007) label the semiotic layer of an activity system "conversation and division of labour", and the technological layer "communication channels and protocols". In this study, conversation and division of labour were defined as "allocation and distribution of roles, responsibilities, workload and power", which was further categorised as "allocating leadership positions / distribution of power of and/or responsibility for learning activity" and the "distribution of workload".

Sub-category	Category	Description	Code	Empirical example: ICT-based communication channel	Empirical example: Non-ICT-based communication channel
Acquisition	communication to enable acquisition	showing, demonstrating, describing, explaining	PMA	"I just give them the website, where they can find it. Like we were doing something about Arts... and I was using the Kwa-Zulu Natal Cultural centre. And maybe they can go... and see what's interesting to them" (Interviewee no.10).	"Maybe if I did a good assignment, and got 80%... maybe I would share with other people" (Interviewee no.10).
	communication to acquire	attending, apprehending	PLA	"Especially for Accounting, because he's very fast. He explains so fast. So I just record sometimes when I feel that I'm tired ... my brain cannot concentrate anymore... I just record sometimes when I feel that I'm tired.... my brain cannot concentrate anymore... I just record. And then I'll come and listen later" (Interviewee no.1).	"There's some stuff which, if someone else explains it, it becomes simpler" (Interviewee no.7).
Discovery	Communicating to enable discovery	guiding or setting up opportunities for discovery	PMD	"When you're going to the computer, you will be diversifying... you'll be getting the views of different people. And then it will be easy for you to understand. Ja... it helps you to diversify and improve your mind and your knowledge as well" (Interviewee no.11).	"We are given assignments, most of the time. Like, in Education, they will give us a topic to research about... they'll tell us to go research about OBE, maybe, as a topic" (Interviewee no.3).
	Communicating to discover	investigating, exploring, browsing, searching	PLD	"I think ICTs are essential because other people are doing researches on the computer, so they really need to find out what they're supposed to do" (Interviewee no.1).	"Maybe we have a particular subjectt that we want to study. And then it has its own sections. And thten maybe a particular person might go and study and check on that particulr section. And then actually we will all go out and try to find information relative to the sectiton that we will present to the colleagues" (Interviewee no.3).
Dialogue	Communicating to enable dialogue	setting up, framing, moderating, leading or facilitating discussion	PMDI	"On chat, we'll say things like, 'how did you go with that test?', 'What do you think about it?', 'What did you write for that question?'" (Interviewee no.8).	"Once you meet with people are you're in a group, you can be able to know, OK, ... this is what they don't understand. So now you give them... or you talk to them, and you try to explain to them what you know. And then it's easier for you to capture the thing, you know. That's what I like" (Interviewee no.5).
	Communicating to engage in dialogue	discussing, arguing, sharing	PLDI	"We did the work, and we gave it to the one person who volunteered to type it. He did it, and he had a problem. And he organised us to meet, and he told us he did the work, and he told us he is going to send our emails so that we can read it and make some edits with bold type, so that he can see the edit, and just come out with a completely marked assignment, so that it can be submitted" (Interviewee no.6).	"It's good to share some things with people. Because another person... or every person has got his or her own insight. So you will be sharing and understanding. Ja, and you'll get more from the other people. You can something back to you. That you never understood" (Interviewee no.11).
Revision	Communicating to enable revision	setting up opportunities for revision, providing feedback	PMP	"I help other people on the UFH chat room because it's... I think it's easy. And it's fun. Because you are chatting... you just write there quickly. You access the work, and then you give it back" (Interviewee no.10).	"We get past question papers, and we go question by question. That's how we revise" (Interviewee no.7).
	Communicating to revise	Experimenting, practicing, repeating, accessing feedback	PLP	"Because the chat room is quick. I can just say, 'please look at my file', and then just send it. 'Just look at this sentence structure', and then the friend will come back and say, 'no, instead of using this word, you can use this one.' So it's faster than the email, the chat. Because it's online, right there. And you get the feedback straight away" (Interviewee no.10).	"When we're studying together, we practice mos chemistry. Because chemistry is about practice. So we practice, and we practice, and if you have something that you don't understand, then you can ask someone to explain it to you" (Interviewee no.5).
Creation	Communicating to promote creation	Facilitating	PMC	"We just sit together. We print it out, and then we sit together, and we say, no, you can change this or that. Then she goes back to her work, and re-arranges. Then we take the flash disk, and put it together" (Interviewee no.10).	Interviewer: How do you resolve disagreements in your study group? Interviewee no.6: It's to find the information leader, like the lecturer or the tutor... to clarify. Whereby you are referring somewhere, so that you can see what is right. Where someone will say... this is the way to do..
	Communicating to create	Articulating, experimenting, making, synthesising	PLC	"I'm thinking... I'm probably going to make a website where the student can research on. Like, a website on management. So when the first years are doing management, and they'll be researching. Maybe I'll advise and give them some things. I'll advise them to visit my site" (Interviewee no.11).	"We had a lot of time... trying to draw, trying to visualise, trying to have... what-you-call... visual pictures of the whole database" (Interviewee no.3).

COMMUNICATION/DIVISION OF LABOUR (semiotic layer): Conversation and division of labour

Sub-category	Category	Description	Code	Empirical example
Allocation and distribution of roles, responsibilities, workload and power	Allocating leadership positions / distribution of power	Allocation of responsibility for leadership of learning activity.	CR	"There should be a primary leader, who will understand the whole concept of the project" (Interviewee no.3). "So ja, I prefer tutors, in the sense that they have an upper hand. They've gone through the stuff that you went through... they know it" (Interviewee no.2).
	Distributing workload	Distribution of workload between peers	CD	"We usually divide this work into sections, ne. That you go and do this section, you go and do this section" (Interviewee no.3). "Because she's living at Pick 'n Pay, and I'm here... we have to do 50-50... And then we print it out, and then we sit together, and we say, 'no, you change this or that'. Then she goes back to her work and re-arranges." (Interviewee no. 10).

Table 12: Operationalisation of high-level AT concept: Communication / Division of labour -- Conversation and division of labour

Just as Laurillard's (2002) media forms provide useful categorisations for technological tools, the teaching and learning events from her Framework provide a means to categorise learning and teaching "events" or communicative roles: acquisition, discovery, dialogue, practice and creation. The table below outlines the ways in which Laurillard's teaching and learning events have been categorised as communicative approaches to mediating ("teaching" in Laurillard's work) and learning. The descriptions for each category have been taken from Czerniewicz and Brown's Framework (2005). Thus, "showing", "demonstrating", "describing" and "explaining" are categorised as mediating approaches to enable acquisition, while attending and apprehending are categorised as learning approaches to acquire. Communication to guide or set up opportunities for discovery are categorised as "communicating to enable discovery", while investigating, exploring, browsing and searching are categorised as "communicating to discover". Mediating through dialogue (setting up, framing, moderating, leading or facilitating discussion) is labelled "communicating to enable dialogue", and "communicating to engage in dialogue" encompasses discussing, arguing and sharing. "Practice" in Laurillard's Framework has been modified to "revision", in order to prevent confusion with Practice theory (Curnock and Hardiker, 1979). "Setting up opportunities for revision" or "providing feedback" are categorised as a communicative approach that mediates revision, and "experimenting", "practicing", "repeating" and "accessing feedback" are categorised as "revising".

COMMUNICATION/DIVISION OF LABOUR (technological layer): COMMUNICATION

Table 13: Operationalisation of high-level AT concept: Communication / Division of labour -- Communication

Each interview was coded using the tables above, in the manner of the example below. Codes and categories were distinct, and sentences containing more than one code were split as separate rows (for example, rows 9 – 11 in the excerpt below).

	Extract	Code	Description
1	Last year, ne... what happened, we had a computer science problem.	O1	Object: Computer science assignment
2	We were doing database.. we were designing database.	O1	Object: Designing a database
3	You see, this project, they said we must have, whatyoucall,	PMC	Communicating to

	a problem. Maybe about anything that you want to do our database concerning that specific problem that we have identified.		promote creation
4	And we have come up with, hey.. Why don't we do a database that will simply say, that will accommodate all students in the university, but making sure that those students are in the same faculty?	PLC	Communicating to create
5	In the same faculty, they will know their own... they will know their own lectures, their studies, and their results can be reflected from the same database.	OC	Outcome: Project outcome
6	Which means you can get the lectures concerned for the course, you can get the student of the same course, you can get their results, and their track record, when you look at their studies. And that programme will assist these faculties, like the faculty of Education, which have many students studying from other faculties, but they are the student of the Education... whatyoucall, the Faculty of Education.		
7	And we design that, because we had this team, we were drawing a lot of diagrams, in terms of trying to visualise... how do we approach... how do we come up to say, this is the total complete product of the database that we had.	PLDI	Communicating to engage in dialogue
8	We had a lot of time... trying to draw, trying to visualise, trying to have... whatyoucall, visual pictures of the whole database.	PLDI	Communicating to engage in dialogue
9	At the end of the day, we did manage,	OC	Outcome
10	but through the help of other people,	CS	Other FHU students who are not part of interviewees' study group
11	that we asked to help us with the queries.	PMA	Showing, demonstrating, describing, explaining
12	Because there were major issues when we do these. whatyoucall, when we do this programme. Because we should include these queries, that when you enter the whatyoucall, the database, if you want a maybe a certain item in that database, the item should reflect.	C	Contradiction between PLC (communicating to create) and GM (study group members' ability)
13	It should not give you something else when you ask for the name of a particular student. It must actually give you the name of the student. And you will find that we have a lot of blocks that we have to make sure that we get information for.		
14	And then you'll find that there'll be a mismatch of results that you get from this database, and it gave us a small challenge.		
15	But with consultations of books...	TCF1	Hardcopy information accessed offline
16	and asking other people	CS	Other FHU students who are not part of interviewee's study group
17	and we managed to complete the project.	OC	Outcome
18	The other issue that we failed, and the group had failed to do, is that we had a similar programme, we had a similar task,	OC	Failed to complete the task
19	but it was unlike in computer science, where we usually do assignment as a group,		

20	and we usually construct information from books,	TCF1	Hardcopy information accessed offline
21	Internet and so on.	TCF1	Electronic information accessed online
22	And you find that the issue of groups... it was a problem.	GM	Peers in interviewee's study group
23	Because you'll find that it was during the exam time, and people were submitting their Dps for the exam.	C	Contradiction between 2 objects: completing individual assignments vs. completing group assignments
24	And they were submitting their work and everything.	CD	How workload is distributed between members
25	And we had a major problem, because some other people were not cooperating.	C	Contradiction between DoL and Community
26	You'll find that maybe 2 or 3 people were doing the project,	CR	Allocation of responsibility for leadership of learning activity
27	and even the use of technology in that one, for them to send us these emails, has not been... whatyoucall... easy. For all of us.	Tcom1	Software applications for communicating at different times
28	Because you'll find that someone will say, no, this is my flash... this is what I have researched.	TCS1	Hardware for storing and sharing content
29	And when you go to the same flash, 1, you'll find that the flash is not working, because the flash has a virus in itself.	IA	Reliability of equipment
30	And then you'll go up and down searching for that particular person: Why don't you give us that information? Because that thing you gave us is failing us.	PMDi	Communication to promote dialogue
31	And then he says, "no, I will email you, because... "	TCS1	Software for storing and sharing content
32	and then you'll find that when you do that, you'll find that the Internet is not working. You can use the Intranet only.	IA	Internet access
33	You can't access the Internet.	C	Contradiction between Rules and Tools
34	And then we'll have these miseries of technology not working, and people not collaborating at the same time.	OC	Outcome: Failure of technology and peers to collaborate
35	So you'll find that using technology can be a frustration.	IA	Reliability of equipment
36	Sometimes, it can be a better thing if people cooperate.	PMDI	Communicating to promote dialogue
37	And even itself, sometimes you will find that the technology cooperates, because sometimes it doesn't cooperate the way you want it to cooperate.	IA	Reliability of equipment

Table 14: An excerpt of coded data

4.5 Validity

4.5.1 Introduction

Kvale (1989, cited by Morse et al, 2002, p.14) states that "to validate is to investigate, to check, to question and to theorise". Ensor and Hoadley (2004) remind us that in order to satisfy the requirements of validity and reliability, a study's analysis and findings should be presented such that readers have access to the method of analysis as well as sufficient data. The analytical framework and its categories and codes have been detailed comprehensively in this chapter. In that which follows, the findings are presented together with excerpts from the data. In this section, the various threats to validity in the research design are presented, and the efforts to address them described.

4.5.2 Types of validity and strategies for addressing them

Maxwell (1992) identifies five broad categories of understanding or validity relevant for qualitative research: descriptive validity, interpretive validity, theoretical validity, generalisability and evaluative validity. The first four of these are relevant for this study, and their implications are discussed in this section. Morse, Barrett, Mayan, Olsen and Spiers (2002, p.1) argue that during the conduct of enquiry, qualitative researchers should implement "integral and self-correcting" verification strategies to ensure trustworthiness and utility. They posit "investigator responsiveness, methodological coherence, theoretical sampling and sampling adequacy, an active analytic stance, and saturation" as strategies for ensuring that rigour is built into the research process (p.9). In this section, Maxwell's broad categories and Morse et al's (2002) strategies are discussed with regard to the approaches adopted in this study.

Writing about descriptive validity, Maxwell (1992) identifies two types, which he terms primary and secondary descriptive validity. By the former, he refers to the accuracy of data collection during fieldwork – for example, the quality of a recording or the specificity with which notes were taken. For this study, the primary validity concerns are around whether or not what interviewees said was accurately recorded and transcribed. In addressing potential threats to primary descriptive validity, the interviews were transcribed either the same day that they were conducted or the following day, to maximise the interviewer's recollection where interviewees' responses may be difficult to understand due to the quality of audio recording, contextual interruptions (e.g. wind blowing, or builders working), and the volume at which interviewees spoke, or nuances in accent.

Writing about secondary descriptive validity, Maxwell (1992) refers to "the validity of accounts of things that could in principle be observed, but that were inferred from other data – for example, things that happened when the researcher was not present". A key strategy for improving validity in this study has been the collection of data from two sources (survey and interviews). However, as all of the data for this study is self-reported, and comprises interviewees' descriptions of their own and their peers' attitudes and behaviours, the question is, "do the interviewees accurately report these things?" As interviewees initially completed a survey questionnaire almost a year prior to being interviewed, there was opportunity to ask some of the questions again. This gave some insight into the secondary descriptive validity of the survey questionnaires, and an opportunity to improve on the trustworthiness of the survey data. However, it was only during the once-off face-to-face interviews that additional clarifying and probing questions could be asked to improve the descriptive validity of the interview data.

In her study on students' use of media for peer-to-peer learning in a distance learning class, Haythornthwaite (2001, p.216) analyses students' self reports of frequency of communication.

She notes that "self-reported frequency data are not expected to be objectively accurate, but are expected to allow comparison across relations and across media, to give a general indication of low, medium and high frequency communicators." She notes that such data "should be taken to indicate a relative rather than an absolute measure", but maintains that self-reporting allows consistency of data collection across all means of communication, as while electronic communication logs are possible, comparable data are not available for face-to-face or telephonic communication.

Additional threats to secondary descriptive validity include the potential reactivity of interviewees who, aware of the researcher's interest in ICT and peer-to-peer learning, may have been prompted to present a more favourable viewpoint of these ways of learning than they would otherwise. In an attempt to address this, it was stated clearly to interviewees upfront that the focus of the research is on whether or not these ways of working are useful, and that honest discussion and description of their own and their peers' attitudes and behaviour would best serve this need.

Maxwell (1992) reminds us that claiming that a phenomenon (for example, the use of mobile phones to coordinate study group meetings) occurs frequently or rarely is subject to threats to descriptive validity. This threat presents itself in this study in two key ways: the use of self-reported behaviour and the number of interviewees. For example, what does the finding that "many interviewees described how they collaborated on group assignments by working around one computer" actually mean? In an attempt to address this, the use of what Becker (1970, cited by Maxwell, 1992) calls "quasi-statistics" - simple counts of things to support implicitly quantitative claims – are used as much as possible. However, despite these efforts, the extent to which interviewees engage in peer-to-peer learning or use ICT in peer-to-peer learning activities is difficult to gauge. Although questions along these lines were posed in the survey schedules – for example, "How often do you work with other students on an online document (e.g. wiki)" , with three options for a response: "Hardly Ever"; "Sometimes" and "Often", it became evident during the interviews that students had very different interpretations of what constitutes frequent use than the researcher. Also, as the adoption and use of technology is a fast-moving and constantly changing behaviour, it is likely that interviewees' patterns of ICT use are constantly changing (e.g. one interviewee used to use Mxit at the time of being surveyed, but at this time of being interviewed, he no longer had a cell phone with that functionality). A better approach to dealing with this threat would be that adopted by Haythornthwaite (2001), who examined changes over time, by collecting data from students at three points during one term, in order to better capture the evolution of study groups, as well as members' growing capacity to use ICT over time.

Writing about what he terms interpretive validity, Maxwell (1992, p.288) notes the importance of ensuring that the study captures what the objects, behaviours, events and settings "mean to the people engaged in and with them". By interpretive validity, Maxwell refers to the perspective of the researched – for example, their "intention, cognition, affect, belief [or] evaluation" (p.288). In an effort to ensure interpretive validity as Maxwell understands it, the categories developed for the analytic framework comprise words and phrases that captured key aspects of peer-to-peer learning activities, or appeared in more than one interview. He writes that "interpretive accounts are grounded in the language of the people studied and rely as much as possible on their own words and concepts". Simple, straightforward questions were posed to interviewees, and terms such as "ICT" and "VoIP" were fully explicated to ensure common understanding between the researcher and the researched and promote interpretive validity in the study.

At first consideration, it appears that a strategy of confirming results with participants may have improved the interpretive validity of this study. Due to time constraints, this was not

done. However, Morse et al (2002) note that responsiveness to particular concerns of participants may lead researchers to a more descriptive level in order to address participants' individual concerns, and may actually invalidate the work of the researcher by shifting the level of analysis "inappropriately close to the data" (p.8).
Theoretical validity addresses the theoretical constructions that are brought to or developed during the study. Maxwell (2002) identifies two types of theoretical validity – the validity of the concepts or categories from the theory as applied to the phenomenon being studied, and the validity of the relationships which the theory construes as existing between these concepts or categories. The first type exists to the extent that the research community supports the use of Activity Theory triangle nodes to guide the development of categories to analyse students' self-reported peer-to-peer learning activities. Towards this end, chapter three details the history, development and application of activity theory. The previous chapter argues for applicability of the theoretical framework to investigate peer-to-peer learning and unpack the role of ICT. Sampling early adopters who use ICT to learn with their peers led to saturation and replication in the data. As Morse et al (2002) explain saturation in the data leads to replication in categories which engenders verification, comprehension and completeness; thus promoting theoretical validity. AT studies are usually focused on interventionist, experimental and/or design-oriented applications (Engeström, 2007). To a lesser extent, AT is used as a framework for observational studies (e.g. Waycott, 2004) and analysis of text from a students' discussion forum (e.g. Ab Jalil, 2005).

In order to promote the validity of the relationships construed between high-level concepts and the categories developed for each, two key strategies were adopted: drawing heavily from the literature (as described in this chapter) and garnering input from the research supervisors. Both supervisors for this study have extensive experience in conducting similar research. Joanne Hardman has recently completed her PhD dissertation where she developed a language of description, including categories and codes for analysing data from classroom observations with activity theory. Laura Czerniewicz uses Laurillard's (1993, 2003) framework and has published extensively on the use of ICT in tertiary institutions. These supervisors' probing questions as to the precise meaning of each category helped to promote reliability and ensured that the categories and codes were understood by fellow researchers. I also drew from the work of key additional theorists, namely Engeström (1999), Sharples et al (2007) and Laurillard (2002).

Morse et al (2002, p.12) assert that in working towards analytic goals, coherence between the various methodological components and the data is achieved through the verification of each component with the methodological assumptions of the study as a whole. Methodological coherence was sought through three key strategies in this study: purposive sampling (the identification of early adopters of ICT for peer-to-peer learning); ensuring that the interview schedule was informed by the theoretical framework and key research questions; and the adoption of an iterative approach in developing the analytical framework and conducting the analysis. The authors (2002) maintain that analysis is self-correcting when the principles of qualitative enquiry are followed. They write that "a good qualitative researcher moves back and forth between design and implementation to ensure congruence among question formulation, literature, recruitment, data collection strategies and analysis". In order to ensure a good fit between the research questions, theoretical framework and data collection and the conceptual analysis of the literature and the data, the processes involved in developing the theoretical framework and collecting data and developing the analytical framework and analysing the data were carried out in parallel where possible. Morse et al (2002, p.11) argue that the more responsive the researcher, the less muddled and confusing the categorisation scheme. They write that "it is essential that the investigator remain open, use sensitivity, creativity and insight, and be willing to relinquish any ideas that are poorly supported regardless of the excitement and the potential that they first appear to provide". There was a

plethora of interesting data beckoning the investigation towards tangential paths, and commitment to the key research questions and the theoretical framework was important to ensure that the analytical framework was appropriately honed for the study.

The theoretical framework of this study heavily influenced the collection, analysis and discussion of the data. Assumptions that mediation, the use of tools and interaction between learners promote learning underlie the study's research design, and hence could potentially affect the validity of this study. Although the researcher sought to maintain awareness of the bias around the usefulness of peer-to-peer learning (I do not have the same bias regarding the use of ICT), it is likely that this impacted on the validity of this study in a number of ways – from the answers and stories the interviewees chose to share, to the coding categories developed and choice of interview data to foreground in the presentation of findings. Ensor and Hoadley (2004) maintain that using any framework "inevitably introduces a systematic "bias" into the research in that it acts selectively upon classroom life in order to answer certain specific types of questions" (p.7). They write that "theory inevitably shapes the collection of continuous data, guiding what the researcher foregrounds and backgrounds... Data analysis is an iterative process that brings theory and data into dialogue with each other in order to generate categories and claims" (Ensor and Hoadley, 2004, p.2). The reliance on the theoretical frameworks described above necessarily introduces bias, as the framework informs the way in which data is captured, analysed and ultimately presented in the following chapter. In order to address this, the theoretical basis and definitions of key terms have been stated upfront.

The small sample size for the *Access and Use* survey poses reliability problems, and as such, although the findings do give us some idea of the extent to which students use ICT for learning, they are not generalisable. The sampling frame for the first phase of this research is biased in that there was no sampling design. A FHU student was paid per completed questionnaire that he was able to collect, and his mode for doing so was based on convenient access to students that he knew, and those he could access in university residences, libraries, and on campus. As the sample was not randomised, the Survey findings are neither statistically representative nor generalisable. For this reason, this study focuses only on data from the Survey schedules of the eleven interviewees. Generalisability for this study thus refers to the extent to which the findings can be generalised within the sample (Maxwell, 1992). As all the data is self-reported, and collected during once-off interviews, the internal validity question for this study is the extent to which interviewees' opinions, thoughts, behaviours and the effects thereof are reflected by their reports of these things and the researcher's interpretation of these reports. As it is impossible that every aspect of the interviewees' perspectives about and experiences of peer-to-peer learning and the role of ICT would have been expressed during the interviews, it is likely that false inferences about these things have been made in this study.

This section has sought to flag potential threats to the study's validity, and has outlined the strategies adopted to address them. These strategies will have varied levels of success in promoting the trustworthiness of the research design, process and findings, and the latter should be viewed in light of the study's shortcomings.

4.6 Research ethics

This research project adhered to the formal ethical protocols outlined in UCT's code of ethics. The identity of all participants has been kept anonymous, and no names are mentioned in the paper.

All respondents in the *Access and Use* Survey participated voluntarily. The survey

questionnaire also provided respondents with the option of anonymity or providing their name and contact details. In addition, the questionnaire asked respondents to tick a box to indicate whether they are available for a follow-up interview. All potential participants for the second phase of this study thus indicated their willingness and availability to participate before being contacted.

4.7 Conclusion

Ensor and Hoadley (2004) note that studies using strong theoretical frameworks are often criticised for non-reflexivity, circularity and lack of capacity for change or development. Their response to this critique is that where theoretically-driven descriptors or categories are "brought into dialogue with the data", redescription and development necessarily arise. This process has been clearly illustrated in this chapter, whereby the key theoretical framework from Sharples et al (2007) has been developed into an analytical framework incorporating both key issues arising from the data and Laurillard's theoretical work which has enabled the operationalisation of some of the high-level concepts from the original theoretical framework. The development of the analytical framework in this study, which operationalises Activity Theory in an innovative way, is an arguably useful contribution to the field.

Daweti (200) writes that "as we talk, inquire, interact and open ourselves to other forms of knowledge, we contribute to the rebuilding of an infrastructure that, according to Laurillard (1993), will match the academic values we wish to preserve and the new conditions for educating larger numbers and diverse groups". While the findings of this study cannot be generalised beyond the small sample, the efforts to maximise the study's validity promote the usefulness of its findings for better understanding the relatively understudied phenomenon of peer-to-peer learning at a South African university and the role of ICT.

Chapter 5

Data analysis

5.1 Introduction

This chapter focuses on interviewees' descriptions of, opinions about and insights into their peer-to-peer learning experiences, and the role of ICT in these interactions. The key questions this chapter seeks to answer, using the language of AT and the analytical framework detailed in Chapter 4, are: How do the interviewees learn with their peers? And what is the role of ICT in this activity?

For the purposes of this study, students in a similar age cohort to the interviewees (within five years of age) were categorised as "peers". Thus, while some peers were classmates of the interviewees, others were a few years further along in their academic careers. This included peers who, employed by the University, fulfilled the role of a formal tutor. Peers with a more advanced level of understanding or skill, as identified by the interviewees themselves, are referred to as "more-able peers". Those deemed by the interviewees to have lower levels of understanding or skill are referred to as "less-able peers".

The first substantive section of this chapter details the objects identified in interviewees' self-reported peer-to-peer learning activities. Each object signals a particular activity, and the three objects to which interviewees referred to most were identified for further analysis. The identification of these objects – (i) preparing for a test or exam, (ii) completing a group assignment and (iii) assisting a less-able peer to do either of these) – is the first step in outlining the activity systems in which they occur. These three activities have been termed cooperative peer-to-peer learning, collaborative peer-to-peer learning and peer-to-peer tutoring respectively, in line with terms from the literature on peer-to-peer learning (Howes, 1999). The discussion of each of these activities is structured according to the analytical framework outlined in the previous chapter.

5.2 Tracking objects

As explained in the previous chapter, the analysis sought to identify two types of objects in the interview data:material and ideal. Students' objectives when engaging in peer-to-peer learning, as well as their implicit and explicit beliefs about the phenomenon, led to the identification of objects and the points at which they shift.

The material foci of interviewee's peer-to-peer learning activities and subject matter include Accounting (specific examples include an assignment on TAX law); Education (e.g. an assignment on the theories of child development); Computer Science (e.g. developing a database for a group assignment); Chemistry; English; Mathematics; Botany; Zoology and Business management. In addition to the subject matter of their degree courses, interviewees spoke about interacting with peers to develop ICT skills (for example, learning to go online using a mobile phone and learning how to use email).

Passing tests and exams and completing assignments were the most commonly expressed ideal objects. The objectives driving these include the completion of courses and ultimately, graduating. As Interviewee no.2 expressed so emotively, "I'm fighting a battle to complete the degree".

For most, the driving motivation behind graduating is employment. Interestingly, many

interviewees also linked the object of learning to use ICT with increased likelihood of gaining employment. When asked, "Why do students build ICT skills?" interviewee no. 2 responded: "They know that in order to excel, they've got to know these things. We're living in a world of globalisation, and we're not operating in isolation. So the only way is to get networked". Interviewees also spoke about using ICT to seek and access employment opportunities (e.g. compiling curriculum vitaes and applying for internships or placements at companies online, or "researching the companies I want to work for").

Interviewee no.6, who is studying Education, described his motivation for studying as stemming from a desire to uplift his community: "I want to firstly improve my education. Especially in my area, there are few who are educated. And I want to educate them. Show to other people that education is important... just carry on with our education, and try to be able to lift the level of education, and help them to reach a higher level".

Overall, interviewees spoke about the inter-related objects of completing assignments, passing tests and/or exams, developing ICT skills, passing courses, graduating and securing employment. Both short and longer-term objects were identified. Passing a test is a more immediate object towards the ultimate object of graduating or gaining employment. Interviewees' discussion around the ways in which they learn with their peers was far more focused on immediate objects, and it is hence upon these that the analysis focuses.

5.2.1 Analysis of key peer-to-peer learning activity systems

Once the data had been coded according to the schedule of categories outlined in the previous chapter, all the objects discussed above were listed in a spreadsheet. Those to which interviewees referred most were highlighted for further analysis.

Both kinds of objects (material and ideal, as described above) were identified in the data. However, the wide range and variance in material objects made the identification of patterns between activity systems with different material objects difficult. The objects common to all interviewees were found to be ideal, and pointed to the motivations for which they engaged in peer-to-peer learning.

Responding to questions about the ways in which they learn with their peers, interviewees spoke most often and in most detail about preparing for tests or examinations and completing assignments. Many also described assisting a less-able peer, or being assisted by a more-able peer, to achieve these objectives.

The following key objects were thus identified for further analysis:

(i) preparing for a test or exam,

(ii) completing a group assignment and

(iii) assisting a less-able peer to do either (i) or (ii)

Each of these objectives was mapped as the objects in the activity theory triangle described in the previous chapter. The analysis then mapped the data which had been coded accordingly to the rest of the nodes in the triangle framework. The theoretical framework outlined in the previous chapter, which builds on Sharples et al's (2007) and Czerniewicz and Brown's (2003) work, provided the scaffolding for the analysis.

In the analysis, interviewees were the subjects of the activities they described. Students working with one another in order to prepare for tests or exams were found to work in different ways and contexts to those focused on completing a group assignment. Interviewees' objects were also found to shift from preparing for a test or exam and completing a group assignment to providing guided assistance to a peer to do these things. The analysis thus led

to the identification of a third activity which was found to interact with the first two.

Patterns of peer-to-peer learning activities emerged, and detailed descriptions of these comprise the substance of the following sections in this chapter. Following of Howe et al's (1999) work, the activity systems mapped around these three key objects are labelled cooperative peer-to-peer learning, collaborative peer-to-peer learning and "peer-to-peer tutoring" respectively.

Analysing the data through the multiple lenses provided by the analytical framework enables an in-depth exploration of how students learn together, and the role and impact of ICT. In order to illustrate the process and initial findings of the analytical process, the three activity systems are described below according to the nodes of AT as developed by Sharples et al (2007).

5.3 Activity 1: Preparing for exams or tests with peers

The most-cited object for peer learning which interviewees discussed was exam or test preparation. Once all the data had been coded as described in the previous chapter, each of the relevant nodes for activities with this object were mapped onto the AT triangle. The results of this analytical are unpacked in this section and depicted in figure 8 below.

Figure 8: Preparing for tests or exams with peers

At the time of being interviewed, nine out of eleven interviewees were members of groups that study together in order to prepare for tests or exams. Every interviewee had at some point in their student career been a member of such a group. Thus the first two nodes of the AT triangle were identified: the object of the activity being test or exam preparation and the subject the interviewee. In mapping the pattern of this activity, the analysis sought to identify its objects and the semiotic and technological layers of the subsequent nodes of the triangle:

- Mediating artefacts (using Laurillard's media forms to describe tools in the technological layer)
- Control
- Context
- Communication (using Laurillard's communicative roles to describe the technological layer)

5.3.1 Mediating artefacts

5.3.1.1 Semiotic tools

Most exam/test preparation learning activities between peers were found to play out face-to-face. The key semiotic tool employed was language. The complexity of the language, accent of the speaker and use of home languages were key factors affecting the semiotic tools in this activity.

Four interviewees highlighted the usefulness of explanations in "simple" language, compared to "the complicated explanations that you may find from your lecturers". Two noted the importance of peers for discussing academic work in familiar accents. In the excerpt below, interviewee no.4 contrasts the difficulties he has understanding his lecturer's accent with the accessibility of his peers' communication.

Extract 5.1

> "Sometimes it's difficult to understand the lecturer or the tutor. Sometimes they do not explain very well, so then I go to the other students... Some lecturers, I don't understand the way they pronounce names... I don't get what they're saying. I'm working very well with my peers...

> Everything they state is clear" (Interviewee no.4).

Two interviewees noted the importance of being able to communicate in one's home language, which they find easier with peers than tutors and lecturers, who communicate exclusively in English.

Extract 5.2

> "... using the language maybe... maybe sometimes I will ask using my mother tongue, and then it's easier to talk to colleagues, rather than your lecturers or your tutors, because they are using basically English" (Interviewee no.3).

5.3.1.2 Technological tools

Interviewees primarily use narrative media in this activity system. The key technological tools to which they referred when speaking about this activity are textbooks and past exam papers. Hardcopy information accessed offline are the most widely utilised tools, although two thirds of the interviewees indicated that they also search for content online. Interestingly, in most cases this information is printed or written down and then taken along to cooperative learning sessions.

Extract 5.3

> Interviewer: When you're studying for exams with your peers, how do you do it?
> Interviewee 7: We get past question papers, and we go question by question. That's how we revise
>
> Interviewer: Do you discuss them, or do you write them down?
>
> Interviewee 7: We discuss them, and there are some things that you need to write down.

The use of ICT for learning in this activity is limited, as students work face-to-face in groups, usually using hardcopy learning materials, pens and paper. However, every interviewee found ICT (namely phone-to-phone and/or Internet-to-phone SMSs, or mobile phone calls) useful for coordinating the logistics of the study group and scheduling meetings. Two interviewees spoke about the use of synchronous communicative media (PC-based IM for communicating with study group members for discussing their academic work), and only one spoke about the use of productive media (she uses her mobile phone to record lectures and share audio files with her study partners.)

5.3.2 Context

5.3.2.1 Semiotic (community)

Daniels (1996, citing Minick et al, 1993. p.18) remind us that "educationally significant human interactions do not involve abstract bearers of cognitive structures, but real people who develop a variety of interpersonal relationships with one another in the course of their shared activity in a given institutional context". As each interviewee spoke about the ways in which they study, the role of study partner - fulfilled by their classmates, friends, and, in one case, a boyfriend - was described in detail.

Reasons interviewees provided for studying with their respective study groups include "I know and like them"; "they are doing the same courses as I am" and "they are people who are serious about studying". Interviewee no.3 describes how the familiarity between peers promotes ease of communication and understanding in the following excerpt:

Extract 5.4

> "It's that the colleagues are most close to me. Like, we are friends. It's easier to communicate with them rather than a lecturer or a tutor. Maybe we will have that gap... like a tutor is a teacher. We are not familiar in understanding... The communication and the understanding... is the major thing. Like, when those people, they know you, and they understand you, and they even understand maybe your limitations. It's easy for you to form a group with such people. Because you'll find that most of the groups, some people they do not understand each other... that as a result, the group will certainly vanish, because they do not understand their weaknesses and strengths and those things... (Interviewee no.3).

The interviewee's description cited here elucidates her perception that peers' close understanding of one another's abilities is important for the longevity of study groups' cooperative learning activities.

5.3.2.2 Technological (physical context)

All the interviewees engage in this activity on campus, in auditoriums, the library, in computer labs and in their residences.

5.3.3 Control

5.3.3.1 Semiotic (social rules)

Social norms affect the ways in which study groups are established and the frequency and length of their meetings. Different expectations, or codes of conduct, were found to exist for different groups. Group learning processes were structured varyingly, and interviewees' descriptions of these provide interesting insight into the ways in which members of the respective groups learn together.

Group composition and meeting schedules
Typically, each interviewee has a core group of regular study partners. Interviewees described study groups where members join and leave on an ad-hoc basis, and others which maintain the same membership throughout the duration of the course for which they're studying. Some groups were described as more fluid than others, and group composition ranged from a study partnership between two people who had been studying together for two years, to the more common setup of a group of four to eight students studying together for a semester or a year. Some interviewees' peer learning groups meet regularly throughout the semester, while others meet exclusively in the weeks leading up to exams or tests.

Code of conduct
Social norms were found to influence interaction between group members, as well as expectations around the extent to which members apply themselves to their studies.

Speaking about the social rules governing interchanges within his study group, interviewee no.3 highlighted the importance of "attitude". He said, "some other people are moody... some are friendly... and usually you want to spend time with people who are friendly to you, and can understand you better".

Another spoke about the requisite work ethic for her study group:

Extract 5.6

> "...it's very very crucial that if you're in our group, you study. Even if there's no test or exam, you study all the time in order for you to be prepared, so that when the test comes you don't need to panic, and you don't have to stress" (Interviewee no.5).

All of the interviewees described the tendency for study groups to socialise around personal, recreational or social objects in addition to the object of learning, and for many interviewees,

socialising between study group members was seen as important. A minority of interviewees' relationships with their study group members were purely focused on academic support. For most, relationships with study group members were also friendships, with time spent socialising as well as learning together.

Group learning processes
A priority identified by most interviewees is that the work is understood by each member of the group. The speed of progress is thus determined by the slowest member, as it is only when everyone in the group understands that they can move on.

Interviewees' groups were found to follow similar patterns in the ways in which they structure their learning.

More than half of the interviewees described the workflow processes when preparing for a test or exam using past exam papers or assignments. Below is an example of the typical response to the question, "how does your group study when preparing for a test or exam?"

Extract 5.7

> "We study the textbook. And then you come with your questions. And then you come with past exam papers if you're going to write an exam, and you study those question papers. And you go study alone after you have studied with them again" (Interviewee no.4).

5.3.3.2 Technological (human-computer interaction)
These learning activities play out face-to-face, and as mentioned above, the use of ICT is – for most interviewees - largely limited to the coordination of group logistics.

Mobile phones are the most widely utilised ICT in this activity, and interviewees identified two rules affecting its use. The first, mentioned by every interviewee, was the barrier of telecommunications costs which limit the extent to which students can communicate with one another via mobile phone. The second is a rule imposed by FHU which limits access to web-to-phone SMS services in the labs to certain hours.

All interviewees' Internet access was limited to on-campus computer labs and their mobile phones. The lab rules thus significantly impact this activity system. For example, access to certain sites (e.g. facebook and vodacom4me) is available only at certain times in the day "and that's when people rush to the Internet thingy... it's packed then" (Interviewee no.2).

"Load shedding" (when Eskom cuts off the electric current on certain lines when the demand becomes greater than the supply) also severely limited students' computer and Internet access, and most interviewees referred to the instance a few months prior to the interview when there had been no electricity on campus for over a month.

In this activity, students primarily use ICT to coordinate the logistics of meeting as a group, and for accessing learning materials.

The geographical proximity of study partners was found to affect interviewees' use of email for communicating with study partners. One interviewee, whose classmates spend a part of the week in East London, often communicates with them via email and IM from the Alice campus. However, members of study groups living in close proximity to one another (as were the groups to which the majority of the interviewees belong), find less use for email and IM.

Extract 5.8

> "I see them... I can say, every hour, because we stay in the same res, and we're in the same class, so it doesn't make sense for me to communicate with them by email" (Interviewee no.1).

Although not a widespread phenomenon, some interviewees spoke about using ICT for purposes beyond coordinating the logistics of cooperative learning activities. Interviewee no.3

spoke about his use of Mxit to acquire information about the content of lectures he had missed. Interviewee no.8 described his use of PC-based IM for discussing a test with his study partners, and notes its inferiority to face-to-face conversation:

Extract 5.9

> "On chat, we'll say things like, 'how did you go with that test?', 'What do you think about it?', 'What did you write for that question?'... But it's not like face-to-face conversation" (Interviewee no.8).

5.3.4 Communication

5.3.4.1 Semiotic (conversation and division of labour)

The allocation of mediating and learning roles and responsibilities, as well as the workload is shared equally amongst the peers. Power is mainly distributed horizontally, with students sharing equal responsibility. Foot et al's (1990) description of equality in cooperative peer-to-peer learning resonates with the findings of this analysis, as interviewees' study groups are equal in terms of "both equivalence of age and stage of cognitive development and equivalence of knowledge or skill in the task or problem to be sold".

Where increased mediating responsibility and power is afforded to one peer, the student's object shifts from preparing for a test or exam to assisting fellow peers to do so. This shift in object prompts another activity (described in detail below), which interacts with this one.

5.3.4.2 Technological (communication channels and protocols)

The two overarching communicative roles that students were found to adopt when engaging in cooperative learning are dialogue and revision.

Dialogue

In this activity, students with similar levels of ability and understanding discuss and share the course content, prompted by textbooks, past exam papers and lecture notes. The key advantage interviewees identified when describing this learning activity is the opportunity it provides for sharing understanding with one another. Many described the ways in which conversation and dialogue builds understanding in this learning activity system, and the following excerpt is typical of interviewees' descriptions the "shared understanding" that emerges through dialogue:

Extract 5.10

> "The advantages of working in a group is that people cannot understand the same thing. So when you are sharing, it's good to share some things with people. Because another person... or every person has got his own insight... his or her insight. So you'll be sharing an understanding. Ja, and you'll get more from the other people. You get something back to you. That you never understood... so that's good (Interviewee no.11).

The following excerpt is an example of the perception that most interviewees shared regarding the communication and conversation between peers:

Extract 5.11

> "The synergy element comes in, like the whole is greater than the sum of the individuals. When you think on your own, you get limited. But when you think along a certain line, some people

> can pick it up, and you can come along with different formulas... a quicker method, a quicker way... you'll find the solutions much quicker and easier in some instances" (Interviewee no. 2).

Sharing information (listed as one of the strategies for dialogue in Czerniewicz and Brown's (2005) Framework) is an important aspect of this activity. Despite the range of ICT applications available for sharing information (from social bookmarking[26] to online collaborative documents), interviewees spoke mainly about bringing hardcopy content (either written down or printed) to study group meetings. One described how she records lectures with her mobile phone and shares audio files with her study partners who download them from her PC:

Extract 5.12

> Interviewer: Do you ever voice record anything, while your tutors are explaining something.. how do you remember what they said?
> Interviewee 1: I do that. I use my phone... especially for accounting, because he's very fast. He explains so fast. So I just record sometimes when I feel that I'm tired.. my brain cannot concentrate anymore.. I just record. And then I'll come and listen later.
>
> Interviewer: And then do you download from your phone anywhere, or do you just listen from it?
>
> Interviewee 1: I listen, and put it on the computer.
>
> Interviewer: And then do you share that recording with other people at all?
>
> Interviewee 1: Ja, if they want. They sometimes come to get it.
>
> Interviewer: And how do they know that you have it?
>
> Interviewee 1: I tell them that, "I'm tired now. I'm just recording the lecture, because I'm tired. My brain cannot concentrate anymore. And then I record. They know that.

Revision

The other key communicative strategy adopted by students engaging in this activity is revision. Every interviewee described the process of "practicing" calculations, and going through past papers. In the following excerpt, interviewee no.9 describes processes whereby students use question papers and their peers' responses to mediate their learning:

Extract 5.13

> Interviewee 9: We do these chapters... these courses where you need to calculate. And we practice... question papers, and everything... that is something that we get.
> Interviewer: When you go through the question paper, do you discuss each answer, or do you write down the answer and then discuss what you wrote?
> Interivewee 9: Yeah, we write. And see what each other wrote.

Interviewees were found to combine dialogue and revision when engaging in this activity.

5.3.5 Outcomes

A major advantage interviewees described when detailing their test and exam preparation with peers is that the activity enables them to scaffold one another's learning and progress through their ZPDs, beginning with the identification of what it is that they do and do not know or understand. One interviewee described how preparing for a test with her peers enables her to identify her zone of proximal development:

26 Social bookmarking tools (e.g. *digg* and *delicious*) enable users to save bookmarks or web resources. They accommodate self-tagging / classification, as well as sharing with friends and networks (McLoughlin and Lee, 2007).

Extract 5.14

> "When you're on your own, you'll tell yourself that it's right. This thing that's wrong, ne. but when you're in a group, you see everything that you don't understand. When you are alone, you... it's difficult to see everything. So you'll ask your friends" (Interviewee no.9).

The following excerpts are indicative of every interviewee's opinions about the benefits of studying with peers.

Extract 5.15

> "You know, when you are studying [alone] you don't even know if you understand this thing. But once you meet with people and you're in a group, you can be able to know, OK, this is what I don't understand, and this is what they don't understand" (Interviewee no.5).

Extract 5.16

> "There is some stuff which, when you're doing on your own, you don't really understand. But there's some stuff which, if someone else explains it, it becomes simpler. The way you understand it. So it's like that when you work with others. You get to know some things better" (Interviewee no.8).

However, the outcomes were not all positive, and the possibility that peers could "mislead" one another was mentioned by two interviewees.

5.3.6 Cooperative learning to prepare for exams or tests

Foot et al's (1990) definition of cooperative peer-to-peer learning resonates with the findings of this analysis, as interviewees' study groups are equal in terms of "both equivalence of age and stage of cognitive development and equivalence of knowledge or skill in the task or problem to be sold". The allocation of mediating and learning roles and responsibilities, as well as the workload is shared equally amongst the peers. Power is mainly distributed horizontally, with students sharing equal responsibility. Different approaches to the division of labour were adopted at different times and by different groups: where some groups work systematically through exercises or texts together, others divide the work and allocate responsibility for building the group's understanding of respectively assigned sections or topics.

Peer learning activity systems with the object of exam or test preparation are thus labelled "cooperative". The system, as analysed above, is depicted in figure 8 below.

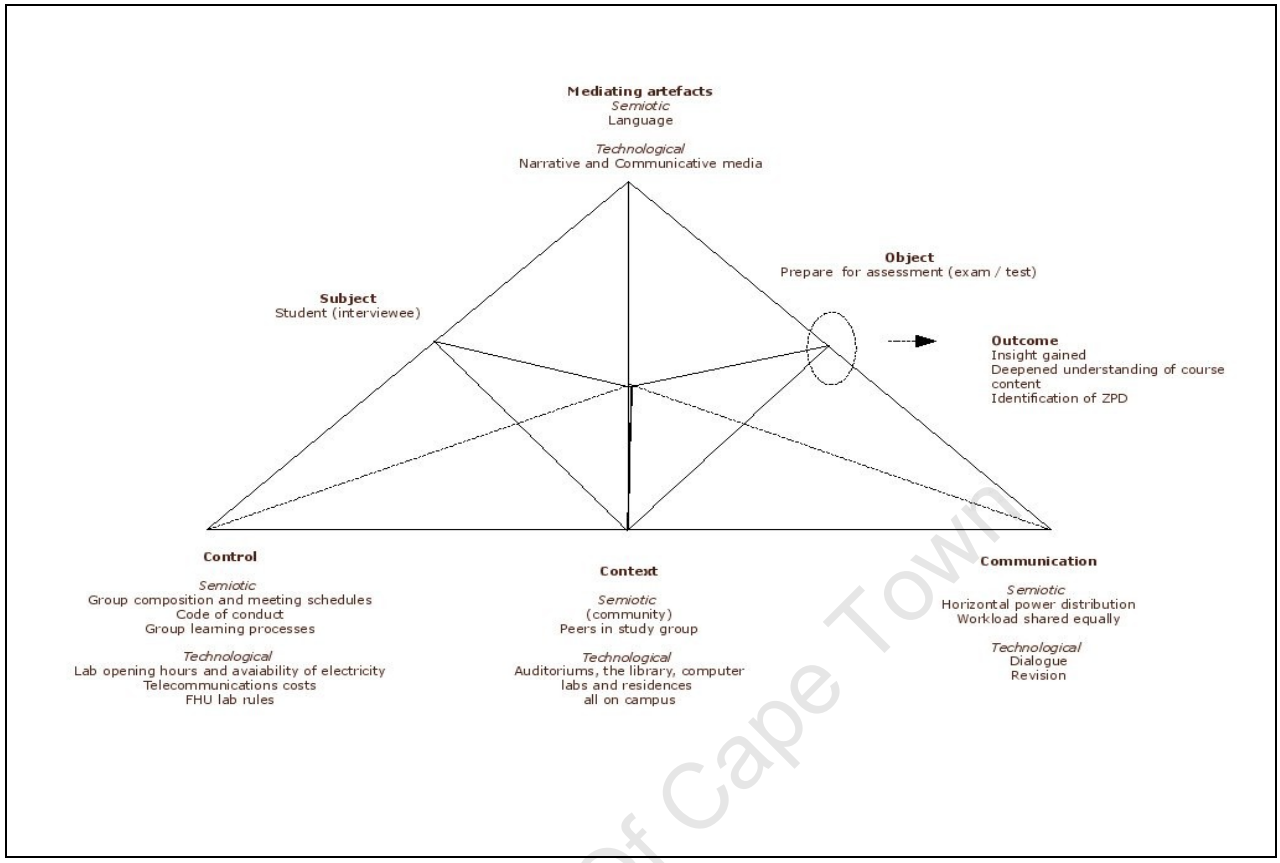


Figure 8: Cooperative learning: Preparing for tests and exams with peers

5.3.7 Contradictions

The key contradictions encountered in this learning activity results from the clash between the **control** and **communication** nodes. For example, the semiotic rule that everyone in the group understands a concept or problem before moving onto the next slows the pace at which students reach the object, and four interviewees described this as frustrating.

Extract 5.17

> "It takes too much time... you are maybe five, ne. And you are not the same. Some catch faster... yeah, some take time to understand. So when you are a group, you have to understand all of you" (Interviewee no.9).

One interviewee's response to the question about the disadvantages of working with peers provides insight into the effect of the slow pace. In the excerpt below, she describes the tension between the rule that everyone in the group understands and the frustration experienced due to the subsequent slow progress. As evident from the excerpt below, her response to the situation where she is taking longer than her peers to understand (and is thus responsible for limiting the amount of content covered in a finite time) results in failure to meet the object of the activity.

Extract 5.18

> Interviewee 7: "Sometimes I... say yes, when I don't really understand."

Interviewer: "So you say that you understand when you don't?"

Interviewee 7: "Yes"

Interviewer: "Why do you do that?"

Interviewee 7: "Because the time is short"

Interviewer: "Why don't you study with them for longer?"

Interviewee: "I don't know... honestly, I don't know."

An effect of the tension between the depth of and pace at which subject matter is covered sometimes leads to superficial coverage of many content areas, as opposed to in-depth study of specific problem areas. Dialogue and revision - the communicative roles primarily adopted in this activity – do not appear to readily offer opportunities for targeting learning to the specific learning needs of each student. This contradiction leads some interviewees to adopt an alternative strategy: self-study.

Extract 5.19

"I think that to work alone is very, very nice. Because working with peers will take a lot of time. Instead of studying, you are just browsing the modules... instead of going straight to the point. And when you're working alone, you know your strengths, you know your weaknesses. And you can just go straight to your weaknesses" (Interviewee no.10).

In the excerpt below, the interviewee describes another effect of this tension, where focus shifts to the less challenging aspects of the work to be covered:

Extract 5.20

"I believe studying alone helps you with personal improvement. And you focus more on your weaknesses, rather than dwell on the group thing, where you waste time with what you're good at... It slows your progress sometimes" (Interviewee no. 2).

His response to this contradiction is to study alone, where he finds that the opportunity to spend more time on the more challenging aspects of the work impacts positively on the pace of progress.

The social rules present in some study groups stipulate that members like one another, enjoy one another's company and are friends. Some interviewees spoke about the tendency of a shift in object from learning to socialising, as a result of the communicative roles that study group members adopt in cooperative learning, which stem from the high equality between members. Interviewees indicated that socialising often obfuscates the object of learning and one described the frustration she experiences when her study group spends time gossiping or joking around rather than studying.

The analysis also led to the identification of contradictions between the technological communication channels and protocols (the technological layer of the division of labour / communication node) and the rules governing the social use of the tools (in particular, IM and Mxit on personal computers (PCs) and mobile phones). The social norms and rules around the use of certain ICT limit their usefulness for learning (and in some cases, can actually inhibit learning). For example most of the interviewees who use it, described IM - and in particular, Mxit – as a tool that they apply solely to social, rather than learning, objects. They all described the adverse impact that Mxit and other synchronous ICT can have on learning, and the following excerpts are examples of interviewees' widely-held opinions of the use of IM.

Extract 5.21

> "I don't use Mxit. I only just send SMSs. I'm not a Mxit person... I'm not... The thing is, I've many friends that are into Mxit... people I know. And I notice them that they all... they lose their attention. They mix more than they study. So I'm the type of person that is really afraid of being hooked... I'm not saying it's the wrong thing... it depends on the person. But me... if I started to use Mxit, I would just Mix all day and all night. So I don't want to go in there, into that habit. It's the type of person I am" (Interviewee no. 5).

> "No-one will ever be interested to chat about academics. They'll just be interested in music, or movies... You know students, when they're chatting, they think it's break time, or just free time to do something else... not to work. Because they will try to get as far away from schoolwork as possible" (Interviewee no.1).

Students' resistance to using this tool impacts upon is relevance and usefulness to others:

Extract 5.22

> "My friends don't use Mxit, so I don't have someone to chat with" (Interviewee no.9)

Another contradiction between the human-computer interaction aspect of the **control** node and **communication** became evident when interviewee no.7 expressed his need for a "bigger screen for chats and stuff" to use the technology for learning purposes.

The contradiction between **context** and **communication** is evident in interviewees' descriptions of the impact of their community's (study partners') low levels of ICT use on the potential uses of these tools for cooperative peer-to-peer learning.

Extract 5.23

> "Most of them, they don't have email addresses. Because some of them are like, they don't know computers" (Interviewee no.2).

Extract 5.24

> "Not everyone checks email regularly. So if you need to get something urgent, maybe someone will only check the week after, so you can't really use that" (Interviewee no.8).

5.3.8 Conclusion

All interviewees participate in cooperative learning activities, which largely occur face-to-face. Group members are usually friends, and the activity most often takes place on campus (in auditoriums, the library or rooms in residences). The key tools employed when preparing for exams or tests are textbooks and past exam papers. While all interviewees used ICT to coordinate the logistics of study group meetings, only two used IM for discussing course content and one used her mobile phone and PC to share content with her peers. The social norms governing study group meetings affected the pace and focus of group study activities and factors influencing human-computer interaction in this activity included the FHU lab rules and issues of access (e.g. lab opening hours, cost of telecommunications and availability of electricity). In cooperative peer-to-peer learning, power is mainly distributed horizontally, with students sharing equal responsibility. Mediating and learning roles and responsibilities, as well as the workload, are shared equally amongst the peers in the learning group. They key communicative strategies adopted are dialogue and revision.

The key advantageous outcomes identified by most interviewees is the identification of their ZPDs and the opportunity to scaffold through these as they deepen their understanding of course content through dialogue and revision with peers. The main negative outcome identified by interviewees is that peers sometimes mislead one another. The most impactful contradiction in this activity (which in some cases led to the adoption of an alternative learning activity and in at least one reported case the obfuscation of the object) is the clash between social rules governing the activity (namely that each member of the group understands the content being covered before moving onto the next, as well as the importance of social interaction) and the horizontal distribution of power and workload. The negative impact of this contradiction on the pace and depth of learning most often led to the adoption of alternative learning strategies – usually self-study or peer-to-peer tutoring (described below).

5.4 Activity 2: Working with peers on a group assignment

Following studying for tests or exam, interviewees' most-cited object for peer learning was working together with their peers with on a group assignment, with a prerequisite outcome or deliverable. With the interviewees as subjects, the remaining respective nodes of the AT triangle were identified through the approach described above. The findings are detailed here and depicted in figure 9 below.

While some interviewees work on group assignments more often than others (often related to the field of study, e.g. interviewees studying information systems (IS) and Education were found to do so more often than Accounting students), all eleven interviewees had worked on undergraduate assignments with peers more than once prior to being interviewed.

5.4.1 Mediating artefacts

5.4.1.1 Semiotic tools

As with the cooperative learning activity described above, language is the key semiotic tool employed. As described above, the accessibility of peers' language (in terms of the relative simplicity or clarity compared with the "complex language" used by lecturers, as well as articulation in familiar accents or home languages) were identified as important factors affecting the semiotic mediating artefacts affecting this activity.

5.4.1.2 Technological tools

Interviewees were found to employ a range of narrative, communicative, productive and interactive media when engaging with peers on an assignment. Narrative media employed to access content include the assignment brief, electronic content accessed online (websites, journals, online dictionaries etc) and hardcopy content in textbooks, as well as journals and books from the library. USB flash drives were also found to play a large part in enabling collaborative exchanges of information and assignment compilation. Interviewees used mobile phones for voice and text exchanges (both synchronous and asynchronous) and PCs for email and IM to communicate with their peers for collaborative purposes. Key productive media include office programmes (particularly word processing and spreadsheet software), and interactive media such as search engines and online databases are all used to varying degrees by interviewees working on group assignments. One interviewee described how he overcomes the complexity of his textbook by referring to online content and making use of an online dictionary:

Extract 5.25

Interviewee no.4: The textbook we have for IS is very difficult. So it's better to learn it online, than reading its contents.

> Interviewee: Why do you find it easier online?
>
> Interviewee no.4: It gives the real meaning of a thing. And also, there's dictionary online.
>
> Interviewee: So do you use the online dictionary often?
>
> Interviewee no.4: Ja. I first read my textbook, and then I come to the computer.

Interestingly, other productive media tools (e.g. online documents and wikis), although freely available, are not used. In all cases, interviewees' reasons for this were that they had not heard of the tools before, did not know how to use them, or had never considered using them when working with peers.

5.4.2 Context

5.4.2.1 Semiotic (community)

The students are generally of a similar age and level of academic development (using Howe and Tolmie's (1999) language, there is high equality amongst peers). In addition to the interviewees' peers, the members of the community in this activity include the lecturer or tutor who sets the assignment, and support staff including librarians and lab managers or administrators.

5.4.2.2 Technological (physical context)

Groups generally meet on campus or in residences in order to assign roles, responsibilities and sections of work. They then usually disperse, and each person works in solitude on their part of the assignment. They then reconvene in order to piece everyone's' work together before submission.

As mentioned above, none of the interviewees had made use of online collaboration tools such as wikis or online collaborative documents at the time of the interviews. The following excerpts illustrate the key strategy employed by students using ICT for collaborative group projects, which usually involves all members of the group in the same physical space using one computer.

Extract 5.26

> "If you're working on the same project... you just have to all sit around the same computer" (Interviewee no.2).

Extract 5.27

> "It works like this... there's one person on the computer... who's typing and whatever. And then the others are just saying 'do this, do that, change this, change that'" (Interviewee no.8).

In other instances where students collaborate asynchronously with each working in a different physical context, students use email and USB sticks to bring their work together. This is described below in the discussion of the technological aspects playing out in the division of labour.

5.4.3 Control

5.4.3.1 Semiotic (social rules)

In many of the instances where interviewees described group assignment activities, working with peers was one of the requirements for the assignment set by the lecturer or tutor. This is a key difference to cooperative learning where group work is self-initiated. Additionally, in

some cases (although not most) the group composition is also prescribed by the lecturer or tutor. In these instances, students are allocated peers with whom they should work, as opposed to self-organising into cooperative learning groups from which they can engage or disengage with little consequence to their assessment. This rule incentivises students to continue working with a group even when collaboration is difficult. In the following excerpt, interviewee no.2 describes a negative team work experience in a positive light:

Extract 5.28

> "...you have to work out your differences. How to learn to work in a team, and that's when you're supposed to all contribute when you present stuff. And then ja... that's the time when you're really obliged to work with people... and it's exposure to the real world, that's what I will say. Even though I might not like it, in the real world you have to work with people. Bottom line. So it is nice having that experience" (Interviewee no.2).

Other rules that impact upon group assignment activities are those that define the academic timetable and scheduling. Interviewees described the negative impact of due dates for group assignments scheduled during exam time, or periods where students have heavy workloads. In the following excerpt, interviewee no.3 describes the problems encountered when group members' level of engagement and delivery were affected by high workloads:

Extract 5.29

> "The issue of groups... it was a problem. Because you'll find that it was during the exam time, and people were submitting their DPs for the exam. And they were submitting their work and everything. And we had a major problem, because some other people were not cooperating. You'll find that maybe 2 or 3 people were doing the project, and even the use of technology in that one, for them to send us emails has not been...what you call...easy." (Interviewee no.3).

5.4.3.2 Technological (human-computer interaction)

The availability and reliability of ICT was described as a major factor leading to the success or otherwise of efforts to use these tools. An example offered by one of the interviewees illustrates that where students are not working together effectively, technology can sometimes only worsen the situation:

Extract 5.30

> "You'll find that someone will say, no, this is my flash... this is what I have researched. And when you go to the same flash, and that the flash is not working. Because it has a virus in itself. And then go up and down searching for that particular person. And then he says, "No, I will email you"... and then you'll find that you can't access the Internet. And then we'll have these miseries of technology not working, and people not collaborating at the same time" (Interviewee no.3).

In this excerpt, interviewee no.3 describes the effects of the variables controlling access to ICT: accessibility and reliability of tools (e.g. faulty USB drives and viruses) and infrastructure (e.g. lack of Internet access, resulting from both FHU lab infrastructure challenges and Eskom power supply shortages).

5.4.4 Communication

5.4.4.1 Semiotic (conversation and division of labour)

Some study groups assign leadership to one group member to coordinate the project, whereas others simply divide up sections or areas of the project between group members, and work together with shared responsibility for compilation. In the following extract, interviewee no.3 describes the division of labour:

Extract 5.31

> "We usually give each other tasks, ne. To maybe... we have a particular subject that we want to study. And then it has its own sections. And then maybe a particular person might go and study and check on that particular section. And then actually we will all go out and try to find information relative to the section that we will present to the colleagues, so that we can all have equal share of the information that we are studying" (Interviewee no. 3).

In their descriptions of experiences working with peers on assignments, interviewees distinguish research and writing as very separate phases which results in an extensive and time-consuming approach. In this excerpt, the interviewee describes a long process of conversation, division of labour and information gathering before the group goes to the computer and "starts working" on their assignment:

Extract 5.32

> "We usually divide this work into sections, ne. That you go and do this section, you go and do this section. And then we get the information – we write it down, or print it, and then come to the table, and we sit at the table having the information... and then we discuss. And you say, "This is what I have for this project. It goes like this and this and this." And there should be a primary leader, who will understand the whole concept of the project. And so when we discuss, we discuss it in a way that is informed, you see. At the end of the day, you'll find that some of the people they might go and research something that is irrelevant to the question. And so we'll discuss it and discuss it, and maybe we'll take it to the tutors, just to advise us, that maybe we are going on the right track. After that, we maybe go to the computer. If we have relevant information. That is when we start working" (Interviewee no.3).

The group meetings ensure that each member of the group is "going on the right track", that the approach is cohesive and the mutuality (synchronised focus on task and collaboration) is increased. Some interviewees said that they were more likely to speak about seeking input and assistance from tutors or lecturers when working on group assignments.

Another interviewee described the editing process, where changes that need to be made are identified together in person and then carried out by peers working in different geographical locations.

Extract 5.33

> "Because she's living at Pick 'n Pay, and I'm here... we have to do 50-50... And then we print it out, and then we sit together, and we say, 'no, you change this or that'. Then she goes back to her work and re-arranges. Then we take the flash disk, and put it together... and cut and paste" (Interviewee no.10).

5.4.4.2 Technological (communication channels and protocols

The analysis of students' collaborative learning processes yields further interesting findings pertaining to the communication channels and protocols that impact the activity. The two overarching communicative roles that students were found to adopt when working with peers on assignments are dialogue and creation.

Dialogue

Again, the use of ICT was identified as useful for coordinating group logistics (e.g. scheduling group meetings). The use of mobile phones for voice and text exchanges, as well as instant messaging between PCs, was described as useful for the "constant" communication required between members of a group working on an assignment. The following excerpt describes the

ways in which mobile phones support this communication:

Extract 5.34

> "When you're having projects, as students, you need to communicate constantly.'Where're you at?' 'How much ground have you covered?' You can't meet all the time. Sometimes you need to use the cell phone, to just talk things through, and then people will be making progress, wherever they might be" (Interviewee no.2).

The purposes for students' ICT use in this activity extend beyond coordinating logistics. In the following excerpt, the interviewee describes how he and his study partner adopt both mediating and learning communicative roles through dialogue while collaborating on their assignment:

Extract 5.35

> "We just sit together. We print it out, and then we sit together, and we say, no, you change this or that. Then she goes back to her work, and re-arranges. Then we take the flash disk, and put it together" (interviewee no.10).

Although none of the interviewees are using social bookmarking applications (not one was aware that such tools exist), most interviewees spoke about sharing websites with their peers, through email, and by writing down the urls for one another. However, one did not see any use in sharing websites:

Extract 5.36

> "I don't share them. Because there is more information provided by the computer. Just if you... if you write something on google, we write the same thing, and for sure my friends will get it. Because google will give you websites. So it's not a good point to tell them, because obviously they'll get it" (Interviewee no.11).

This student's failure to see the point in sharing the source of online content with his peers is based upon an interesting assumption that his peers will use the same search engine or portal and search terms. A possible factor contributing to this assumption is that he is using the most easily available, accessible and well-known online resources (e.g. Wikipedia), which are likely to be found easily by peers researching the same topic.

Some interviewees reported how they encourage their peer group to adopt and use newer ICT (e.g. two interviewees described how they prompted their peers to use IM). Others attribute their low levels of use of particular applications to their peers' low usage levels (e.g. many interviewees mentioned the irrelevance of email for peer-to-peer learning purposes due to the infrequency with their peers access their inboxes). Some of the interviewees and/or their peers lacked some of the initial competencies required to benefit from using collaborative ICT, as interviewee 10 describes below:

Extract 5.37

> "Some of them... they don't get proper training as we do in Education. So they don't know everything... they just know how to type. They're still going to ask us, how to put the borders, and underline, and stuff like that."

Creation

Productive and communicative media are the key tools used by students working to create something in order to complete an assignment. Examples of assignments mentioned by

interviewees include a paper and a database. Interviewee no.6 shared the following story which details the ways in which the roles and responsibilities are assigned and adopted within the group. His description highlights how the creative process involved in co-authoring a paper is enabled by communicative and productive media.

Extract 5.38

> Interviewee no. 6: One day we were supposed to submit an assignment. We did it and work it out, and we just gave it to the one person who volunteered to type it. And afterwards we gave it to the person, and it was divided, or it was separated, so... he was supposed to just link the information, and the time it was very short. He took it and where he went alone. He did it, and he had a problem. And he organised us to meet, and we met him somewhere. He told us he did the work, and he told us he is going to send to our emails so that we can read it and make some edits with bold type, so that he can see the edit, and just came out with a completely marked assignment, so that it can be submitted. So everyone was supposed to do some changes where it was supposed to be, and send it to the person, so that he can see also the changes... where the changes are made.
>
> Interviewer: And did it work?
>
> Interviewee no.6: Ja, it did. We got 64%. It was Psychology for Educators.

5.4.5 Outcomes

A completed assignment is the main outcome of this activity. Interviewees described outcomes of varying quality, sometimes submitted on time and other times not. Less tangible outcomes include lessons learned from working as a team, improved subject knowledge and skills sharing and development. The use of technology by some members of the group can prompt its adoption by others.

5.4.6 Collaborative learning to complete a group assignment

Holmes et al (1990) found learners participating in collaborative learning to demonstrate high levels of equality (in terms of age and ability) and mutuality (the extent to which learners work together on the same problem). This analysis has found that learners working together on a group assignment in an effective way demonstrate high equality. The levels of mutuality were variable, and appeared to be higher for groups working more effectively together. In some cases, ICT helped to increase mutuality (e.g. mobile phones facilitating constant communication between group members and learners working together on one computer editing their assignment).

Some theorists (e.g. Slotte and Tynjala, cited by Chan et al, 2007) posit a tangible outcome or deliverable as an integral aspect of collaborative learning. Following this, the learning activity of working together on a group assignment has been termed "collaborative learning". The AT triangle that illustrates the connections between each node is featured below, and the contradictions between these connections are highlighted in the discussion that follows.

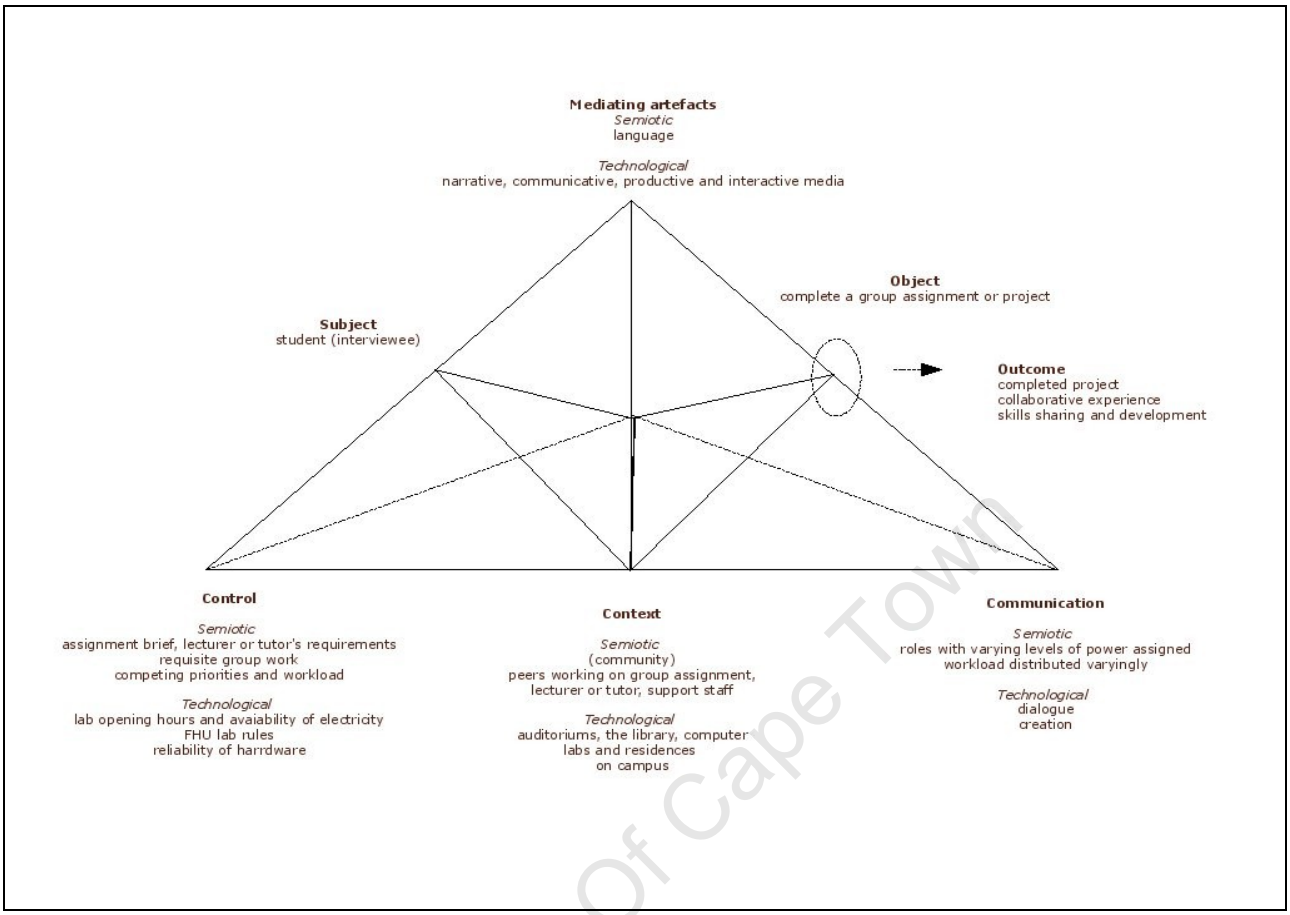


Figure 9: Collaborative learning: Working with peers on an assignment

5.4.7 Contradictions

The key tensions and contradictions identified in this activity are between the **mediating artefacts** and **communication** nodes. The ways in which these collaborating groups organise their work processes and under-utilise the tools available impede their ability to reach the object efficiently. The ways in which interviewees described their groups' work flow organisation, approaches to conducting research, sharing information, developing and editing documents indicate that they're failing to leverage the functionality inherent in many of the tools they are using, as well as many other freely available collaborative online tools. The advantages of efficiency and effectiveness that, for example, social bookmarking offers over writing down URLs and passing them to peers are not realised due to students' low awareness of the existence and availability of these tools. Similarly, using the tracked changes functionality available in every word processing application for collaborative editing is an exponentially more effective and speedy approach than that adopted by many of the interviewees, whereby each member of the team makes changes in separate hardcopy documents, or separate electronic documents using a coloured or bold font, which then have to be collated and integrated manually one-by-one. Students' lack of awareness of the availability of media that would be of great beneficial when engaging in dialogue and/or production is a key obstacle that diminishes the role that ICT can play in collaborative peer-to-peer learning activities.

5.4.8 Conclusion

All interviewees participated in collaborative learning activities, which also largely occurrs face-to-face. In some cases, membership of groups is assigned by a tutor or lecturer, while in others groups were self-selected. In some cases, students were requested to work on an assignment in groups and submit one assignment as a group. In others, students collaborate while each working on their own assignment for independent submission. The activity most often takes place on campus (in auditoriums, the library, rooms in residences and the computer lab). The key semiotic tool employed is language, and interviewees employ a range of technological tools including narrative, communicative, productive and interactive media. All interviewees use ICT to coordinate the logistics of their collaborative work assignment and all use ICT to produce their assignment. Mobile phones are used for voice and text exchanges (both synchronous and asynchronous) and PCs for email and IM. Key productive media used include office programmes (particularly word processing and spreadsheet software), and interactive media such as search engines and online databases. Other productive media tools (e.g. online documents and wikis) were not used.

Key rules found to impact upon collaborative learning activities are those which define the academic timetable and scheduling. Interviewees described the negative impact of due dates for group assignments scheduled during exam time, or periods where students have heavy workloads. Human-computer interaction was affected by the availability and reliability of ICT. In some instances labour is divided equally and power distributed horizontally. In others, a leader is identified by the group and power more vertically distributed. In some cases where the leader is clearly more able than her/his peers, his/her object shifts from completing the assignment to assisting her/his peers to do so. Here, a collaborative activity system interacts with a peer-to-peer tutoring activity system (described below).

The two overarching communicative roles that students adopt are dialogue and creation. A completed assignment is the main outcome of this activity. Interviewees described outcomes of varying quality, sometimes submitted on time and other times not. Less tangible outcomes include lessons learned from working as a team, improved subject knowledge and skills sharing and development. In some cases, the use of technology by some members of the group led to its adoption by others. In other instances, group members' lack of use means that interviewees are unable to collaborate with them effectively using ICT. The key tensions and contradictions identified in this activity are between the mediating artefacts and communication nodes in this activity. The ways in which these collaborating groups organise their work processes and under-utilise the tools available impede their ability to reach the object in efficient ways. The ways in which interviewees described their groups' work flow organisation, approaches to conducting research, sharing information, developing and editing documents show that they're failing to leverage the functionality inherent in many of the tools they are using, as well as others freely available online. Reasons for the low levels of use of collaborative ICT included: interviewees had not heard of the tools before, do not know how to use them and/or their peers do not use and/or know how to use them.

5.5 Activity 3: Assisting a less-able peer

The analysis found in some cases, interviewees' objects shifts from preparing for a test or exam and completing a group assignment to assisting a peer to achieve these objects. This usually happened when one student had superior knowledge, skills or understanding and could thus mediate their peers' learning. Instances where this was described by interviewees include:

- A peer study group preparing for exams has one student explaining a concept or

section of the material to the rest of the group. In these cases, this student has superior knowledge or understanding or has prepared an allocated section of the work for the study session.

- A student enrolled in a higher year of study is employed by FHU to assist less-experienced learners in formal tutoring sessions that are part of the course schedule.
- A more-able peer supports and assists a less-able peer with exam/test preparation or completing an assignment over a long-period of time. In this case, the interviewee had been assisted by her more-able peer (her boyfriend) for over two years.

As a shift in object indicates a shift in activity (Engeström, 1987), a third activity was identified, which interacts with the cooperative and collaborative activities described above. In this activity, a more-able peer assist a less-abled student with preparing for examinations/tests or completing an assignment.

The object for the less-able peer remains that of the original activity (for example, preparing for a test/exam, as in cooperative learning activities, or completing an assignment, as in collaborative learning activities). The shift in object (and hence activity system) from cooperative or collaborative to tutoring occurs for the more-able peer, whose object shifts from their own exam preparation or assignment to assisting a less-able peer. In some cases, for example, when a peer is employed as a tutor by FHU, their object is peer assistance from the outset.

Most interviewees have experienced both subject positions (as the less-able or more-able peer) in different tutoring activities. In some instances, the more-able peer was a student taking the same class, preparing for the same exam or completing the same assignments. In others, they were an employee of the university, tasked with tutoring a class of students studying a year or two below themselves.

5.5.1 Mediating artefacts

5.5.1.1 Semiotic tools

As with the activity systems discussed previously, language and subject content are the primary semiotic mediating artefacts in peer-to-peer tutoring activity systems. Again, the same factors affecting language in the activities described above (accent, complexity of language and the use of mother tongue) impact the activity.

5.5.1.2 Technological tools

The technological tools employed included narrative media (textbooks, past exam papers, assignment briefs), communicative media (SMS, IM, email and phone calls), productive media (word processing software), and interactive media (search engines, online dictionaries).

5.5.2 Context

5.5.2.1 Semiotic (community)

Interviewees described two types of peer-to-peer tutoring contexts

- Formal tutorials that form part of the course schedule, where students are led by an older and more advanced peer, who is paid by the university to help his or her tutees.
- Informal peer-to-peer tutoring scheduled outside of the course timetable by the students themselves, whereby a more capable student assists another that is struggling.

In formal tutoring sessions, students are assigned their community by university administrators or course convenors. Informal tutoring communities are self-organising, and usually comprise students whose relationships extend beyond tutor / tutee to friend, classmate, room mate, etc. When the shared responsibility for engendering understanding in a cooperative or collaborative peer-to-peer learning activity is ineffective, members of the group usually engage in alternative strategies. Sometimes, the appropriate strategy is peer-to-peer tutoring.

Extract 5.39

> "...sometimes, we don't understand something... all of us, we don't get it. So we have to try and get information from someone else... We usually go to other classmates... people that we know. Or if they don't know, then we go and consult the lecturers" (Interviewee no.5).

5.5.2.2 Technological (physical context)

All but three interviewees engage in peer-to-peer tutoring activities exclusively face-to-face. Formal tutoring contexts include auditoriums and lecture theatres, and informal tutoring activities include, in addition to these, other areas on campus such as residences.

Only three interviewees described how they engage in tutoring activities virtually, using the PCs in the FHU labs. Prompted by the lack of students with whom to study face-to-face, one interviewee uses web 2.0 technologies to access peer tutors, whom he meets in chat rooms accessed via the FHU website, as well as via other IM platforms (e.g. gmail chat).

5.5.3 Control

5.5.3.1 Semiotic (social rules)

In formal tutoring sessions, the tutors are paid to tutor and are accountable to the course convenor and professors. Students are often required to attend these tutoring sessions in order to get their DP for the course, and are expected to conduct themselves similarly as when sitting in lectures. The tutors are required to speak English, which was identified by one interviewee as problematic as she finds it easier to grasp concepts communicated in her home language.

Conversely, informal tutoring sessions often rely on the availability, accessibility and willingness of the more-able peer. The interactions are usually one-on-one and range in frequency between a once-off occurrence and regular meetings over a long period of time (e.g. one interviewee has been engaging in peer-to-peer tutoring activities with her peer for two years). The social rules governing these interactions often relate to the nature and status of the personal relationships between tutors and tutees. In informal tutoring sessions, interviewees report mixed use of their first languages and English.

5.5.3.2 Technological (human-computer interaction)

As with the others analysed the rules governing access to computers and bandwidth on campus impact the activity. Issues of cost and level of access were highlighted by interviewees as rules that impact human-computer interaction for peer-to-peer tutoring activities. For example, FHU limits the extent to which students can upload files on the university network, which controls the amount of data that students can share with one another.

Two interviewees described strategies that involve using IM to access a more-able peer (or another member of the community, such as a tutor) to assist them. Interviewee no.2 described how he may even contact the interviewer for assistance. He highlights the cost of using ICT, and how this affects the choice of tool (it is cheaper and easier to explain things "in detail" using IM than a voice conversation).

Extract 5.40

> "Like, if you've got a difficult thing, then you want to access your friends... like someone who's into computers. Like now I've met you, and I know you're interested in IT stuff. And if I've got a problem, I can easily access you on gmail. And we can discuss it, and it'll be easy for us to do that. Instead of you calling me, which might be costly. And you might explain it in detail there".

In the following extract, a more-able peer describes the motivation behind his willingness to assist peers using IM:

Extract 5.41

> Interviewer: Do you help people on [the FHU chat room]?
>
> Interviewee 10: Yes.
>
> Interviewer: Why is that?
>
> Interviewee 10: Because it's... I think it's easy. And it's fun. Because you are chatting... you just write there quickly. You access the work, and then you give it back.

Only three interviewees spoke about the use of IM for peer-to-peer tutoring. The most oft-cited reason provided by interviewees for not using IM were that these applications are more appropriate for socialising, rather than academics, or that they do not know how to use these tools.

5.5.4 Communication

5.5.4.1 Semiotic (conversation and division of labour)

In peer-to-peer tutoring, labour was found to be vertically distributed, with the more-able and powerful peer (the tutor) providing guided assistance to a less-able peer. It is in peer-to-peer tutoring that the roles of mediator and learner are most evident, with the key conversation comprising structured assistance within learners' ZPDs (Hardman, 2008).

In formal tutoring sessions, the tutor is tasked with providing guided assistance to a group of learners. He or she is in a position of power as task assigner and assessor, and the tutorials are part of the course timetable. Some interviewees described tutorials as a useful platform for seeking guided assistance, as the classes have fewer students and the conversation in tutoring sessions was described by many interviewees as interactive and open.

Extract 5.42

> "With tutors, you get to interact with them on a one-to-one basis... they know your weaknesses as well. You relate to them, you're open to them. You have time to do practical questions..." (Interviewee no.2).

Extract 5.43

> "Tutorials... I can prefer tutorials myself, rather than lectures... I think tutorials... you'll be just free. You can ask whatever you want. Whatever your problem... that is where you can raise your problems and it will be surely answered. And be satisfied at that time" (Interviewee no.11).

However, the extent to which formal tutoring is useful depends on the subject content

knowledge of the tutors.

Extract 5.44

> "So ja, I prefer tutors, in the sense that they have an upper hand. They've gone through the stuff that you went through... they know it" (Interviewee no.2).

Extract 5.45

> "Some of [the tutors] don't know their stuff. So they really depend on us, when it comes to the tuts. They don't know their stuff, so they'll be confused, some of them" (Interviewee no.1).

Informal peer-to-peer tutoring occurs outside of the course timetable. In some cases, cooperative or collaborative learning activities interact with tutoring activities, whereby a more-able peer assists the rest of the learners in a group. For example, some of the study groups that interviewees described adopt a method whereby each member takes responsibility for a section, and tutors the rest of the group. In the following excerpt, interviewee no.6 describes how labour is divided between study group members:

Extract 5.46

> Interviewer: How does your study group learn together?
>
> Interviewee no.6: We look at the work that we did, and we select... we share the work... like, topics. You talk about this topic, and another one, and I'll do another topic. And once someone talks about a certain topic, and just share... we all share the information to, and we make some additions and some corrections... The leader is determined by the topic. So actually, you become a leader on that section. So that everyone can participate.
>
> Interviewer: And how do you decide who becomes a leader of which sections?
>
> Interviewee: Mmm the strength of ourself on each and every topic... that will differ. So we can see how does this person, or where he or she is lacking. Or she is having that information, and a clear understanding. So we just take a person... or someone choose for him or her.

The most-able peer for each topic within the subject that the group is studying is assigned responsibility to lead a section of the work that needs to be covered. This excerpt clearly illustrates the interacting relationship between the cooperative and tutoring peer-to-peer learning activities. The object of the student with the most ability or understanding of a particular aspect of the course content is tasked with assisting less-able peers with the relevant content area. The more-able peer's object thus shifts to mediating others' learning.

Another interviewee described the tutee / tutor relationship she has with her study partner. The following extracts highlight the advantages of having access to a more-able peer who provides one-on-one mediation through accessible explanations:

Extract 5.47

> "All the time... when I read, I don't understand stuff, for the first time. So I have to ask him. He understands everything when he reads, so he can help me. He helps me every time" (Interviewee no.1).

Extract 5.48

> "I think he's brilliant.... He's good. He explains better than the lecturers. And I think he gives me more attention, because we'll be only two. Unlike the lecturers, they have divided attention, because they have to give everyone attention" (Interviewee no.1).

Her study partner – whom, it came to light towards the end of the interview is also her boyfriend – is clearly the more-able peer whose object is to provide guided assistance to interviewee no.1. In the following extract, the interviewee describes the process whereby they sit together and read the text, and interviewee no.1 will seek assistance from her study partner when she reads something she doesn't understand.

Extract 5.49

> Interviewer: How does it work when you study together? What do you do?
>
> Interviewee no.1: Um... we read first. Like the textbooks. If it's text, then we read first, and then we go to questions. And then we go to the legislation, to understand what the legislation was.
>
> Interviewer: Do you both just sit and read, or do you read to each other? How does it work?
>
> Interviewee no.1 : If I don't understand a thing, I'll have to ask him, while I'm studying.

5.5.4.2 Technological (communication channels and protocols)

The overarching communicative roles that interviewees adopt for peer-to-peer tutoring are acquisition, dialogue and creation.

Acquisition

Interviewees spoke about adopting both mediating and learning roles. As the more-able peer, the key communication channel is focused on enabling acquisition, and, as the less-able peer they are acquiring. In the following excerpt, interviewee describes how the mediation he received from his more-able peer promotes better recall:

Extract 5.50

> "Sometimes it helps you to remember, when you're writing the test. Because you remember, mm, my friend was emphasising this... so that's good. I think it's something good about it. I think it's good for the memory, if you're the person who likes to memorise and remember... I remember he was saying this, and explaining like this... "(Interviewee no. 11).

Dialogue

As with cooperative and collaborative learning activities, dialogue featured as a key communicative channel adopted by peers engaging in peer-to-peer tutoring.

Extract 5.51

> "Ja, I do [share information found on the Internet] if there's a need for it. If I see that they're stuck somewhere... if they don't know a specific thing. Because they would do the same for me" (Interviewee no.5).

Creation

The interviewee who makes the most extensive use of web 2.0 technologies for peer-to-peer tutoring purposes was the only one without a study group, as he is the only person in his course that stays in residence. He thus finds it difficult to find anyone with whom to study face-to-face; he makes use of the FHU chat room, where he finds fellow students who can help him.

Extract 5.52

> "If you know someone, maybe face to face, you can send them your assignment on the chat. There's a link when you can download and check it while you're chatting. And then you can re-do some things and send it back." (Interviewee no.10).

He explained his preference for using the chat room over email:

Extract 5.53

> "Because the chat room is quick. I can just say, 'please look at my file', and then just send it. 'Just look at this sentence structure', and then the friend will come back and say, 'no, instead of using this word, you can use this one.' So it's faster than the email, the chat. Because it's online, right there. And you get the feedback straight away".

None of the students have uploaded content onto websites or file sharing networks for their fellow students. However, this is primarily because none of them knew how or where to do this. One expressed his willingness to upload his assignments: "Maybe if I did a good assignment, and I got 80%... maybe I would share it with other people" (Interviewee no.10).

5.5.5 Outcomes

In formal tutoring activities, outputs for tutors include gaining experience in tutoring and assisting tutees, improved subject knowledge, and payment. For tutees, outcomes include increased understanding and subject knowledge.

Extract 5.54

> "We can have the situation where you're telling yourself you have enough information, whereby other people are having different information and you can take it in different ways, so you can find that even if you have the same information, but you'll have the different ways of interpreting that information, and answering some of the questions" (Interviewee no.6).

Outputs from informal peer-to-peer tutoring activities include increased understanding of subject content in preparation for exams and / or completed assignment for both tutees and tutors.

5.5.6 Peer-to-peer tutoring

Foot, Barron et al define peer tutoring thus: "one child (the tutor) starts out with superior knowledge to the other (the tutee) and both are conscious of their roles as expert and novice and that the objective is for the expert to impart his or her knowledge to the novice" (1990, p.71).

According to Damons and Phelps (1987, cited by Foot et al, 1990), peer tutoring is "relatively low on equality and high on mutuality". The low levels of equality in tutoring activities was always made very clear in interviewee's descriptions. Even in instances where equality was higher (for example, in a peer study group of students in the same class preparing for the same exam), the role of tutor was consciously assigned to the more-able peer for some periods of group study. Here, the student's object shifts from developing their own understanding to developing that of his or her peers. The mutuality is thus increased, as students work together on the same problem, as opposed to each focusing on their own study and engaging peers as needed.

This activity is thus labelled "peer-to-peer tutoring", and is illustrated in figure 10 below, where the less-able peer (in the triangle on the left) is assisted by the more-able peer (the subject in the triangle on the right).

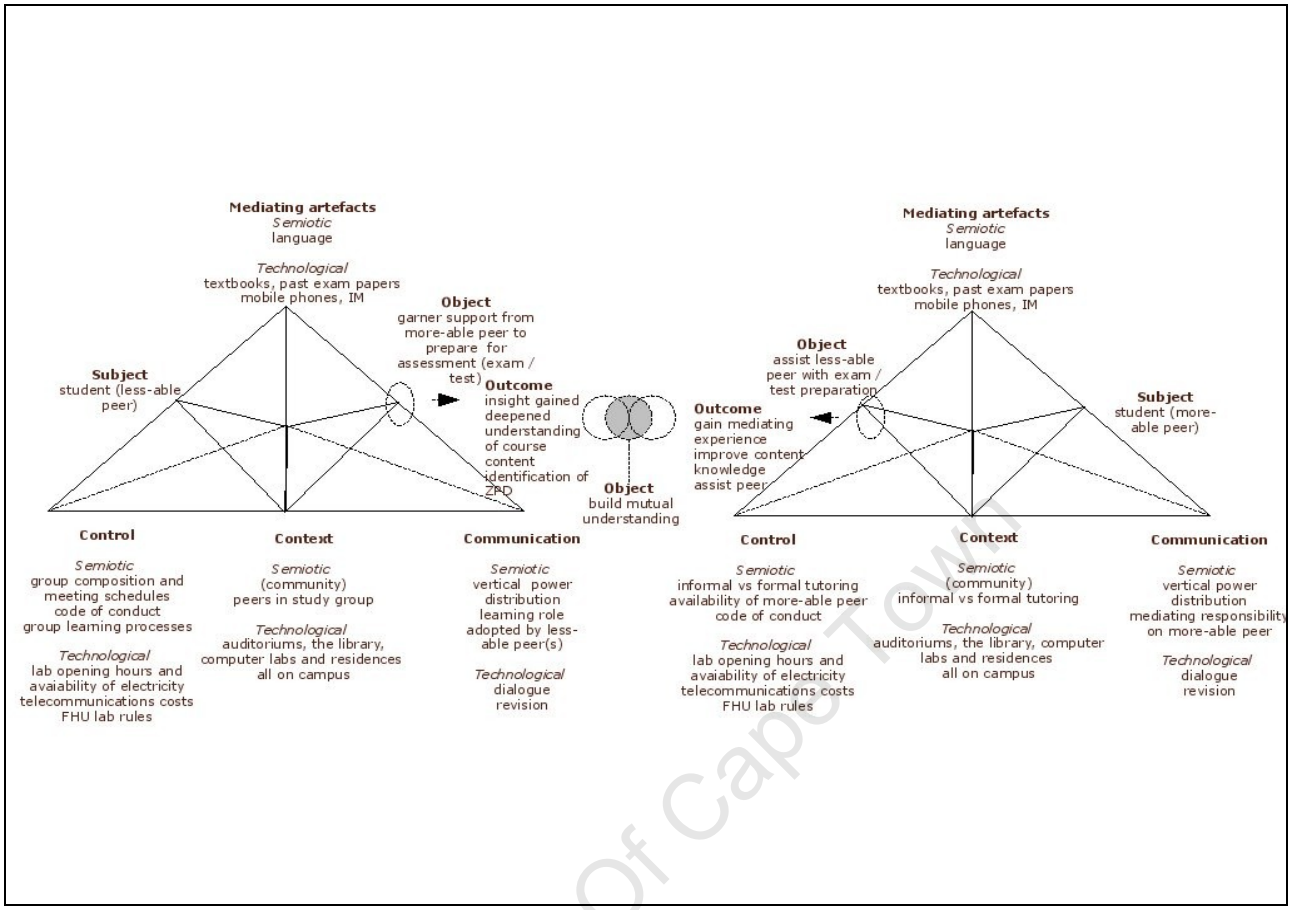


Figure 10: Peer-to-peer tutoring

5.5.7 Contradictions

The key contradictions to emerge in this activity are between the **control** and **communication** nodes. The semiotic control that tutors have in the informal peer-to-peer activity system highlights the disadvantages of relying on a peer for tutoring:

Extract 5.55

> "When we're angry at each other, he won't help me. He'll just say, 'read on your own, I won't help you. Until you say sorry, until you apologise, I won't help you.' So those are the disadvantages of working with him. Because most of the time I rely on him... When you've fought with the person, you really feel that that person won't explain things to you, and then you feel stranded. Because sometimes it's better to depend on your own than to depend on the person who explains to you" (Interviewee no.1).

The following extract illustrates the tension between FHU's control of the technology in the labs and its use for sharing information:

Extract 5.56

> "The peer-to-peer ... was blocked. Because students happened to abuse it... they use it for music, and all sorts of things ... movies...They blocked it at the University of Fort Hare... We don't all have access put stuff on... it's limited. You can't put bigger files and stuff... They've blocked the majority of that" (Interviewee no.2).

This extract also highlights the contradiction between the social rules, that students interact as friends and socialise and the need to share information for peer-to-peer learning purposes. The interviewee describes the students' sharing of music and movies as "abuse". However, a larger amount of space on the network would accommodate students' social use of ICT to share music and movies, as well as to share data for academic purposes (including podcasts and films with subject-relevant content).

5.5.8 Conclusion

The analysis found that more-able interviewees' objects tend to shift from preparing for a test or exam and completing a group assignment to assisting a less-able peer to achieve these objects. The shift in object led to the identification of the peer-to-peer tutoring activity, which interacts with the two activity systems analysed and described above. Two types of peer-to-peer tutoring contexts were identified: formal tutoring (where peer tutors are employees of FHU who tutor during tutorials that are part of the school schedule) and informal tutoring (where peer tutors are fellow students assisting less-able peers and tutoring activities are self-initiated and organised). All but three interviewees who participated in peer-to-peer tutoring activities did so exclusively face-to-face in various venues on campus. The key semiotic tool employed is language, and English is used more in formal tutorials than in informal tutorial activities. The technological tools employed included narrative media (textbooks, past exam papers, assignment briefs), communicative media (SMS, IM, email and phone calls), productive media (word processing software), and interactive media (search engines, online dictionaries). Only three interviewees described the use of PCs in the FHU labs for virtual peer-to-peer tutoring. Prompted by the lack of students with whom to study face-to-face, one interviewee uses web 2.0 technologies to access peer tutors, whom he meets in chat rooms accessed via the FHU website, as well as via other IM platforms (e.g. gmail chat).

Different semiotic rules play out in formal and informal tutoring activities. In the former, students are required to attend sessions as part of their course requirements whereas social rules governing personal relationships between tutors and tutees affect the latter. The rules governing human-computer interaction greatly affect the extent to which ICT is used in the activity. While three students described their use of IM for peer-to-peer tutoring, most interviewees deem IM more appropriate for socialising than for academic purposes and many do not know how to use it.

Labour and power were found to be vertically distributed, with one more-able and powerful peer (the tutor) providing guided assistance to a less-able peer. It is in peer-to-peer tutoring that the roles of mediator and learner are most evident, with the key conversation comprising structured assistance within learners' ZPDs (Hardman, 2008). The overarching communicative roles that students adopt for peer-to-peer tutoring are acquisition, dialogue and creation.

In formal tutoring activities, outputs for tutors include gaining experience in tutoring and assisting tutees, improved subject knowledge, and payment. For tutees, outcomes include increased understanding and subject knowledge. Outputs from informal peer-to-peer tutoring activities include increased understanding of subject content in preparation for exams and / or completed assignment for both tutees and tutors.

The key contradictions to emerge in this activity are between the control and communication nodes. The semiotic control that tutors have in the informal peer-to-peer activity system is a disadvantage for interviewees relying on a peer for tutoring.

Chapter 6

Summary of findings and discussion

6.1 Introduction

In this chapter the findings of this study are summarised and discussed with reference to the literature. Similarities and differences with the findings of other studies are highlighted and areas requiring further research identified. The discussion is structured according to the key research questions around the ways in which students learn together and the role of ICT.

(i) How do students learn together?

The secondary questions which feed into this are:

- What strategies do students adopt when learning with their peers? When and why?
- How are peer learning activities mediated?
- What impact do the contextual and sociocultural factors have on how students learn together?
- What is the role of ICT in peer-to-peer learning?

The sub-questions following on from this are:

- What ICT do students use for peer-to-peer learning, and when?
- What impact do the contextual and sociocultural factors have on how students use ICT for peer-to-peer learning?
- What is the impact of technology on peer-to-peer mediated activity?
- When and how do ICTs inhibit or enable peer-to-peer learning?

The first section focuses on the ways in which students learn together and the second looks at the role of ICT. The chapter ends with reflections on the research process and identifies short-comings. Although this study was not designed to make recommendations, some emerging issues are raised which, if addressed, could potentially promote effective peer-to-peer learning and the use of ICT as an enabler at FHU. Possible areas for further research precede the final conclusion.

6.2 How students learn together

Strategies adopted by students when learning with their peers

Interviewees engaged in peer-to-peer learning towards different objects. Table 14 features those most recurring in the interview data. Separate activity systems were identified for each, and labelled according to Howe and Tolmie's (1990) approach. A group of students preparing for an exam or a test were found to adopt cooperative learning strategies, while students working together towards a tangible output, such as an assignment, adopted collaborative learning strategies. Peer-to-peer tutoring occurs where one student is assisted by a more-able

peer.

Object	Activity
Exam or test preparation	Cooperative P2P learning
Assignment completion	Collaborative P2P learning
Assisting a less-able peer to prepare for a test/exam or complete an assignment	P2P Tutoring

Table 14: Key objects and corresponding activities

For some theorists (Panitz, Resta and Laferrier, 2007; Haythornthwaite, 2001), collaboration involves working towards a common goal. In this study, both cooperative and collaborative peer-to-peer learning feature a common goal, but collaborative activity involves a tangible output in addition. In this research, subjects engaging in interacting peer-to-peer tutoring activities have different goals: The tutee aims to attain understanding or produce an output (e.g. assignment), while the tutor aims to assist the tutee to do so.

While the distinction between each of these activities is marked predominantly by their respective objects, the roles and participation of members in each activity also differ. This aligns with Lehtinen et al's (no date, p.3) distinction between collaboration and cooperative learning. The participants' learning strategies elucidate Rogoff's view of learning as "an effect of community" (1990, cited by Andrews and Haythornthwaite (2007). In this study, the differences extend beyond roles and participation to the rules and norms governing the interactions and the contexts in which they occur. For example, the social norms governing students' personal relationships as friends, classmates or group members greatly impacts their interactions as peers learning together.

The communicative roles, division of labour and distribution of power between members differs in each type of peer-to-peer learning. According to Damon and Phelps (1987, cited by Foot et al, 1990), the levels of equality (equivalence of ability) and mutuality ("extent to which peers are working synchronously on the same aspect of the same problem") are reflected differently in each kind of peer-to-peer learning activity. This study's findings validate theirs. They write that "peer tutoring is relatively low on equality and high on mutuality; cooperative learning is high on equality and low on mutuality; and peer collaboration is high on both" (p.67).

Using Sharples' AT framework to analyse peer-to-peer learning activities highlights the dialectical relationships between AT triangle nodes. For example, the ways in which labour is divided between group members greatly impacts upon the mediating artefacts used and the contexts in which they play out. In this study, power was found to be vertically distributed between more- and less-able peers in tutoring activities, and labour was very divided, as each peer had a different role and object. In cooperative and collaborative learning, power and labour are divided more equally. The levels of mutuality also change, often in accordance with the communicative roles that peers adopt in different peer-to-peer learning activities.

Ways in which peer-to-peer learning activities are mediated

Doise (1990, p.62) writes that "social interaction becomes a source of cognitive progress by virtue of the socio-cognitive conflict it engenders; it is the simultaneous confrontation of different individual perspectives or centrations that gives rise to their integration within a new structure". In interviewees' descriptions of their peer-to-peer interactions, they detailed the ways in which social interaction prompts cognitive processes.

In their descriptions of the ways in which their peer learning activities are coordinated and play

out, interviewees referred to some of what Zurita and Nussbaum (2004, cited by Scanlon et al, 2005, p3) label "conditions for the success of collaborative learning": "the interactivity required to achieve shared goals, the enablement of discussions about the goals; the support of both individual and group outcome achievement; the coordination of participant roles and rules; and the synchronisation and sharing of tasks".

Most interviewees' peer-to-peer learning activities occur face-to-face. The key semiotic tool employed is language, and a range of technological tools (from textbooks to IM) are used. (The role of ICT / media forms is unpacked below). Interviewees' descriptions of their peer-to-peer learning experiences resonate with what Saljo (1999, p.159) describes as the "coordination between language and experience." A key feature of each of the peer-to-peer learning activities was individual group member's conceptions of the material in hand (Howe and Tolmie's, 1999). Different communication channels and protocols are adopted for different peer-to-peer learning activities, as summarised in table 15.

	Dialogue	Revision	Acquisition	Creation
Cooperative learning	✔	✔		
Collaborative learning	✔			✔
Peer-to-peer tutoring	✔	✔	✔	✔

Table 15: Communication channels and protocols

Impact of contextual and sociocultural factors

The interviewees' physical contexts – all but one stay in residence on campus – greatly impacts their peer-to-peer learning activities. That they are mostly in close geographical proximity to one another affects the frequency and means with which they communicate. Similar to Haythorthwaite's (2007, p.223) study, "externally imposed structures" or rules on "intragroup structures" or norms, as well as the object (e.g. upcoming exam or assignment structure) influenced the frequency and nature of group interactions" (p.223).

The extent to which interviewees socialise with their learning partners also ranges. However, in most cases, peers' social relationships with one another greatly impact upon their learning interactions. Liccardi et al (2007, p. 227) note that in addition to group composition, significant factors influencing the ways in which a group functions include "individual-based qualities such as motivation, enthusiasm, previous experience of group work, and communication abilities." They also highlight students' behaviour, attitudes, and levels of encouragement from peers. Each of the interviewees' groups operate in different ways, according to different norms. Each has its own mix of academic and social goals, which are experienced by students in different ways. Liccardi et al (2007, p.227) write that "it is optimal that there are both goal-oriented group members, and socially-oriented people within the same network. Borgatta and Bales (1955) suggest that both are needed in order for a group/network to achieve its goals and have a socially rewarding experience. Liccardi et al (2007) cite Tinto et al (2000) and Kinnunen and Malami (2005) who both emphasise the importance of social support between peers for peer-to-peer academic involvement. Peer-to-peer affective support was a recurring theme in the interview data. As it is somewhat beyond the scope of this study, it is flagged as an area for further research.

"What drives appropriation, and thus development, are the contradictions and tensions between individuals and sociocultural influences, between two or more elements of an activity system, and between different activity systems" (Dobson et al, 2002, p.22). The key contradictions in each of the activities analysed point to the disadvantages of each strategy, as

well as the advantages of the alternative strategies adopted in response. For example, the tension between the control and communication nodes of the AT triangle depicting cooperative learning can lead to the following disconnects:

(i) Cooperative learning groups can tend to study many content areas superficially, rather than carry out focused in-depth study on particular problem areas.
(ii) The social norm that everyone understands before moving onto the next content area is time-consuming.
(iii) There can be a tendency to shift from learning to socialising.

Haythornthwaite (2001) posits the importance of examining use within the context of local needs as norms vary across groups, depend on the types of media available, the tasks to be completed, and previous patterns of use. Researchers that take a socioconstructivist slant on peer-to-peer learning note the heavy influence of norms that govern groups. Interviewees often provided quite detailed descriptions of the norms and expected "attitudes" between peers learning together. Each interviewee's group had distinct norms, but patterns of similarity were found within each type of peer-to-peer learning identified.

6.3 Role of ICT

The use of ICT for peer-to-peer learning

Andrews and Haythornthwaite (2007) maintain that "at its best, e-learning is a reconceptualisation of learning that makes use of not only instructor-led pedagogy but all the flexibility that asynchronous, multi-party contribution can bring." Most of the interviewees were leveraging multi-party contributions in their learning, but most were doing so largely face-to-face.

Although the interviewees in this study were identified as early adopters following their responses to the *Access and Use* survey schedule, the extent and level of their use of ICT was less than anticipated. While most of them indicated in their survey responses that they often "work with other students on online document (e.g. wiki)", it emerged during the interviews that this was not the case. In fact, when working with one another on an assignment, most interviewees explained that one person would work on the computer, with the rest of the group standing around him, reading over his shoulder and providing instruction for writing and editing. This is reminiscent of situations studied by researchers in the early 1990s (Mercer and Wegerif, 1999).

When it comes to academic objectives, ICT is most often used for productive purposes (e.g. typing up an assignment), searching for information and synchronous communication. Interviewees' mobile phones are the most widely utilised ICT for interacting with peers. Although mobile phones are predominantly used to organise and coordinate peer-to-peer learning activities, some use their phones (using either Voice, SMS or IM) to communicate with their peers for learning purposes – most often in collaborative learning activities. Some interviewees use their phones to access the Internet. The most widely used applications in these cases were search engines, IM and SMS via websites. Haythornthwaite's (2001, p.222) research participants were also found to use different media to support different kinds of network connections among class members. Her participants made extensive use of the webboard, IM and email to connect with class members, and conversely did not really make use of telephonic communication.

When contradictions within the activity compromise the object, students adopt an alternative mediation strategy. The contradictions within one learning strategy lead to the adoption of another, and the role of ICT in the above-described activities varies from object to object;

activity to activity. In her exploration of the social networks of interactions and media use among members of a class of computer-supported distance learners, Haythornthwaite (2001) found that structures associated with project teams influenced who communicated with whom, about what, and via which media over the term. She also found that different media were used for specific communication purposes: IM was used mostly for communicating with specific classmates and email was primarily used for intrateam communication.

Interviewees' ICT use was predominantly for enabling peer-to-peer learning, rather than for actual engaging in learning activities per se. While the use of IM and other communicative applications were in some cases extended to academic purposes, the general consensus was that "chat" applications are more suited for social purposes.

	narrative	communicative	productive	interactive
Cooperative learning	✔			
Collaborative learning	✔	✔	✔	✔
Peer-to-peer tutoring	✔	✔	✔	✔

Table 16: Media forms

Students collaborating on an activity with a tangible output, such as an assignment, were found to adopt creative communicative roles and use productive media forms. Where collaborative learning activity systems interact with peer-to-peer tutoring activities, both subjects engage in creation through productive media. Rudimentary functions in productive media - such as printing, cutting and pasting - were mentioned, but none of the interviewees were using online collaborative documents, or even simple functionality such as tracking changes in a word processor. The reasons interviewees provided for not using these tools were that they are unaware of their existence, do not know how to use them, or the peers with whom they are collaborating do not know how to use them.

Impact of contextual and sociocultural factors

The limits to ICT access (effected by a range of factors, from the FHU lab rules to prohibitive telecommunications costs) greatly affect the role of ICT in interviewees' peer-to-peer learning activities. The prevalent opportunities to interact face-to-face decrease the extent to which interviewees' need ICT to communicate. Hiltz et al (2007) include among the advantages of asynchronous communication over synchronous communication that "each person can think about, consult references, compose and revise their contributions at their own optimal speed, before posting them." They explain that "because more time is spent on reflection and on refining contributions to a discussion before sharing them, online discussions are generally found to be "deeper" and more considered than synchronous classroom discussions." As most of the interviewees live on or nearby the University campus, they clearly hold most of their "deeper" conversations synchronously, face-to-face. In her study of distance learners who met in person at two points during their course, Haythornthwaite found the face-to-face interaction had "a catalytic effect" on social and emotional exchanges via media forms thereafter (p.226). It is interesting that the one interviewee without peers from his course living in close proximity was the one to make the most extensive use of ICT for peer-to-peer cooperation, collaboration and tutoring (he adopts both tutor and tutee roles at different times). Clearly, the need to use ICT for peer-to-peer learning will prompt its use – but only when face-to-face interactions are not accessible.

Liccardi et al (no date, p.231) compare face-to-face communication with text-based asynchronous Computer-Mediated Communication (CMC). They write that despite the ubiquity of Web 2.0 technologies such as email, blogs and wikis, these tools "do not have the capacity to support social and affective interaction since this form of CMC lacks the ability to process ambiguous content." They refer to research which considers face-to-face communication to be "the richest, and best for complex tasks" and finds that "nonverbal cues increase speaker-listener interactions".

Writing about the possibilities that ICT provides "for awareness and coordinated action with others", Andrews and Haythornthwaite (2007, citing Bradner et al, 1999) point to the requirement that "users need to work together to create collective uses that are of benefit to the group as a whole, and that in these cases, some users may need to lead use by seeding... such communication behaviours until a critical mass of users and behaviours is established". Lehtinen et al (no date) note the importance of a critical mass of users of collaborative tools, as well as the disproportionate relative incentive for investing time and effort in learning to use them.

"Effective design of technical functionality... requires parallel design of paths that make the user a competent user... User competence is always related to the underlying social practice. Technology adoption requires social learning" (Tuomi, 2007, p.247). Berge and Fjuk's (2006) study on the use of IM and video streaming software found students' activity lower than that hoped for by the lecturer. They identify students' poor typing speed as a key contributor. In this study, the courses that interviewees' were taking appeared to significantly influence their levels of proficiency in using ICT. (For example, interviewees taking courses in computer science, information systems and education were more likely to use more types of different media). Adoption of various ICT applications was also influenced by friends and family members' usage behaviours. Those whose family members live in other provinces or countries were more likely to use a range of media to communicate with their family. The more opportunities and needs students have to use ICT (e.g. for course requirements, or to communicate with family members), the more likely they are to use ICT for peer-to-peer learning. Conversely, students' low usage levels are self-perpetuating.

This study found that patterns of use vary according to changing needs, and interviewees described how, as they come to know and work with their peers and various media, norms develop and change. In order to explore the multi-layered and pronged communication between students in a computer-supported social network, Haythornthwaite (2001, p.214) adopts a social network approach which, she maintains, enables the identification of patterns "of who communicates with whom, about what, and via which media". Her research interests are four-fold: collaboration on class work; exchange of information or advice about class work; socialising and emotional support. She motivates for the inclusion of "non-work" interactions by stressing their importance for creating community bonds and group identity, and found that "face-to-face interaction appears to have been more important for socialising and emotional support than for work-oriented relations." Berge and Fjuk (2006) also found that most IM interaction between students was for social or administrative purposes. Their finding that most students preferred to participate in ICT-enabled peer-to-peer communication and concluded that "interactions of a social or administrative nature are not only legitimate but they are central to building a community of practice". (p.22).

Haythornthwaite (2001) notes that face-to-face interaction is preferred for "ambiguous, socially oriented, and potentially sensitive communications" (p.220). It is interesting that most of the interviewees in this study use media for social communications, whereas work-focused interactions are more importantly face-to-face.

The inhibiting and enabling impact of ICT on peer-to-peer learning

Vandenbosch and Ginzberg's (1996/97) review of the use of what is referred to by Lehtinen et al (no date, p.6) as "groupware"[27] concludes that technologies enhance collaboration when people need to collaborate, they understand the technology and how it can support collaboration, they have support for adopting, implementing and continuing to use it, and they have a culture of collaboration. These criteria were met to varying degrees in the ICT-enabled peer-to-peer collaborative activities interviewees described, and in some cases the ICT appeared to inhibit rather than enhance collaboration.

For many interviewees, the disadvantages of some tools or applications (for example, IM) outweigh the advantages they might have for learning. The distracting, rather than enabling, impact of IM has been picked up by other researchers. Pownell and Bailey (2001, cited by Roschelle, 2003) write that schools are tempted to ban IM in response to its use for "cheating and disruptive behaviour".

Many interviewees in this study referred to the time-consuming nature of cooperative face-to-face peer-to-peer learning. Liccardi et al (2007, p.231) cite studies that find ICT-mediated communication more time-consuming than face-to-face interaction as the latter provides both verbal and nonverbal feedback, and hence groups can more quickly reach consensus. They write that "when the message content included jokes, expression of feelings, self-introductions, compliments, greetings and closures, experienced users rated CMC just as effective as face-to-face conversations." But conclude from their review of the literature that "for complex tasks involving decision making by multiple persons, students express a preference for face-to-face communication."

6.4 Shortcomings of the research process

The exciting possibilities that ICT holds for enabling peer-to-peer learning are likely to have led to research bias. Remembering that research is about what *is* happening, and not what *should* or *could* be happening, was key.

This study is based upon students' self-reported behaviour at the time they were interviewed. As social learning networks and access to and use of technologies are constantly in flux, the findings relate only to a snapshot in time, and follow-up research would likely yield different findings. Interviewees' attitudes during the interviews ranged from anxious and nervous, to engaged and highly interested. Some appeared bored and others were in a rush to finish the interviews.

Technical challenges led to some loss of data (wind picked up by digital voice recorder resulted in the inaudibility of parts of two interviews). Language posed a big challenge. All interviewees were second or third-language English speakers, and the interviewer lacked proficiency in any of the languages with which they were more familiar. In addition, the jargon and terminology infused in conversation about technology posed challenges. The following interaction is an example of the misunderstanding of terminology.

Extract 5.57

Intetrviewer: Do you ever use online documents for collaboration?
Interviewee 7: Ja, we have.

27 A term used in the late 1990s to refer to early ICT developed to leverage the wide-scale networking and collaborating possibilities afforded by LANs, WANs and the Internet.

> Interviewer: OK, can you tell me a bit about that?
>
> Interviewee 7: Ummm... say... say... ok, make it more... ?
>
> Interviewer: So, like, a document that's online, that lots of people can contribute to at once. So like a wiki or a google document or spreadsheet...?
>
> Interviewee 7: Oh... no. We never did that.

In the Access and Use Survey questionnaire, this interviewee indicated that he often works with other students on online documents (e.g.wikis). This inaccurate reporting flags the need for more comprehensive piloting of the questionnaire and inclusion of terminology definitions.

Although many interviewees provided rich, detailed descriptions of their peer-to-peer learning experiences, it's very difficult to get a real sense of how these activities play out without employing observation methodology. Many of the shortcomings of this study's research process would have been overcome through observing and recording actual peer-to-peer learning interactions taking place in addition to interviews with students.

6.5 Issues to be addressed

This research was not designed to make recommendations, but addressing some of the contradictions identified in this research could lead to improved learning and performance by students.

Given that these students are the "early adopters" of ICT from the sample surveyed for the *Access and Use* study, it is likely that widespread basic computer literacy training is required for the larger student body. Contradiction between tools and division of labour for collaborative learning: Important knowledge and skills are required for effective collaboration leveraging ICT, and in many cases, it was student's lack of knowledge about the functionality or availability of certain tools for facilitating and expediting many of the research, writing, editing and document compilation activities they are carrying out. Raising students' awareness of these tools, and their ability to use them, would be beneficial for their learning and working endeavours.

As most students will prioritise the use of ICT for social, recreational and personal purposes, sufficient access is required to ensure that they can carry out these activities as well as for learning. However, the "addictive" nature of some web 2.0 technologies lends support to the FHU's policy of allowing access to certain sites at specific times only.

6.6 Possibilities for further research

As already indicated in the above discussion about the shortcomings in this study, observation studies of students engaging in peer-to-peer learning activities in the range of contexts in which they occur would likely yield interesting data.

Affective peer-to-peer support was identified as an additional communicative role. Each interviewee spoke about the importance of the affective support they both give to and receive from their peers and other members of the community. Many interviewees described the importance of the encouragement and motivation they received from their peers, and the impact that this has on their ability and resilience to keep going with their studies. As this was somewhat beyond the scope of the present study it was not included. However, it is certainly an interesting phenomenon that warrants further exploration.

6.7 Conclusion

> *The computer has... acted as a multi-faceted mirror, reflecting the whole gamut of educational and psychological theories concerning the development of children's thinking. Moreover, the computer has not only lent itself well to assimilation into a wide variety of educational contexts, it also has the potential to transform those contexts* (Light et al, 1990, p.135).

Almost twenty years since Light et al (1990) wrote these words, researchers are still investigating just how easily and well ICT is assimilated into learning and teaching. The FHU students interviewed for this study adopt a range of strategies for learning with their peers in order to prepare for tests or exams and complete assignments, or assist less-able peers to do so. The social rules and communicative roles and media adopted impact on the ways in which these activities play out in context. These factors also impact upon the role of ICT in these activities, in ways that both enable and inhibit learning.

The theoretical and analytical frameworks customised for and adopted in this study contribute to the field of research on peer-to-peer learning and the role of ICT. The findings answer some of the questions that emerged from the *Access and Use* study, and raise new questions. Further study is required to better understand peer-to-peer learning in the information age, such that its advantages can be leveraged and its disadvantages curtailed. Students are learning with and from one another, and the better this phenomenon is understood, the more opportunity there is to leverage it and promote effective learning. There is much work to be done to realise this opportunity, as well as the potential of ICT for "transforming" learning between peers at Fort Hare University.

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Appendix A: Key definitions

In this study, key concepts are defined as follows:

Peers	Peers are defined as fellow students. Although usually classmates, in some instances they are at a higher level of study and hired by the university in a formal capacity as a tutor.
Peer-to-peer learning	"The processes of coming to know through conversations across multiple contexts among [peers] and personal interactive technologies" (Sharples, 2007).
Mediation	Guided assistance (Vygotsky, 1978)
Subject	The individual or primary group of people participating in the activity.
Object	"The meaning, the motive and the purpose of a collective activity system" (Engestrom, 2007, p.337).
Outcome	The effects or outputs that result from the activity (e.g. a completed assignment, improved knowledge, confusion).
Mediating artefacts / Tools	The tools used in mediated activity (e.g. textbooks, mobile phone applications, language).
Rules / Control	The norms, rules or functionality (spoken/unspoken; official/assumed; designed/ unintended) that shape activity.
Context	The physical contexts (geographical and virtual) in which an activity takes place.
Community	The people participating in an activity and its stakeholders.
Division of Labour	"The negotiation of responsibilities, tasks and power relations within an activity" (Hardman, 2007).
Communication	"The communication channels and protocols" (Sharples, 2007).
Semiotic	Signs and/or symbols
Technological	Following Dewey (Hickman, 1990), Sharples et al describe technology as "any tool that serves the purpose of enquiry, enabling people to address problems in context and to clarify and transform them into new understanding".

Appendix B: Access and Use Questionnaire

Appendix C: Semi-structured in-depth interview schedule

Introduction

Thank you very much for making the time to help me with my research. As I explained over the phone, I am a Masters student at UCT, doing my dissertation on the use of technology and peer-to-peer learning by students at FHU. I am interested in the ways in which you learn, and whether, and if so, how, you use technology to do so.

I will not use your real name in my research report, to ensure confidentiality. Is it alright with you if I record the interview?

Demographic information

How old are you?

What is your home language?

And your nationality?

What are you studying?

At what level?

Do you stay in residence, at home with your parents, or in your own place?

What's the occupation of the breadwinner in your family?

What's their highest level of education?

Are you the first person in your family to go to university?

Questions about learning strategies

Do you prefer to study alone, or with peers? Why?

What are the advantages and disadvantages of studying with your peers?

Whom do you think is most useful for your learning: your lecturers, tutors or peers?

If you work with peers, do you always study with the same people, or do you work with different groups?

How did you choose whom to study with?

Where and when do you study together?

When you're working together, how does it work? What do you do? Why?

Questions about the use of ICT

Now I have a few questions about your use of technology, and by that, I mean your use of computers and cell phones.

How often do you use computers?

Where do you use them?

What do you use them for?

How did you first learn to use computers? How did you learn to use the Internet?

When you need new computer skills, how do you get them?

How much of your computer time do you spend on personal, recreational or social pursuits?

What applications do you use for this?

(Talk about interviewees' use of email, listserves, IM, Web-to-phone SMS, social networking sites, blogs, wikis, online collaborative documents, VoIP)

How often do you use your cell phone?

What do you use it for? Why?

What applications do you use on it?

(Talk about interviewees' use of calling, SMS, Mxit, Internet, photography/voice recording)

How do you communicate with the people in your study group? Why? How useful do you find it?

Please describe your use of computers and the Internet for learning.

(Ask follow-up questions to get an in-depth understanding of reported practices)

What kinds of information do you search for online?

(Talk about interviewees' use of online research, learning support materials (e.g. past exam papers, past student assignments), tutorials, course information, etc.

Do you share the resources you find online with your peers? Why? How?

When you are working on a group assignment that requires computer use, how do you do it? Why?

Please describe your use of your cell phone for learning.

(Ask follow-up questions to get an in-depth understanding of reported practices)

From whom do you get emotional support, when you are having a difficult time with your studies? Do you ever use ICT to communicate with them? What is the impact of this?

How useful do you think ICT is for learning? Why?

Why do you think some students make extensive use of ICT and others don't?

Why do you think some students use ICT for learning purposes and others don't?

What is the potential that ICT holds for students in tertiary institutions? How? Why?

Please give me an example of a time when ICT has helped your learning.

Please give me an example of a time when ICT has hindered your learning.

Is there anything else you'd like to say?

Thank you very much!

Information sheet

Please read the following information sheet before beginning the questionnaire.

Dear participant

Thank you for your interest in participating in this research project "A national investigation of access to and use of Information and Communication Technologies (ICTs) for teaching and learning in higher education in South Africa".

Why are we doing this?

The aim of the project is to examine what access you have to ICTs and to explore the ways in which ICTs are being used in teaching and learning.

Who are the researchers?

The study is being carried out by Associate Professor Laura Czerniewicz and Cheryl Brown from the University of Cape Town and is funded by the National Research Foundation.

What do we expect from you in the study?

Participation in this survey is voluntary. By completing and returning this questionnaire, you are agreeing to take part in this research and to the publication of the results with the understanding that anonymity will be preserved. If at any stage you do not wish to continue with the questionnaire you may withdraw your consent by simply not returning this paper copy of the questionnaire. Although this is an anonymous survey, space is provided at the end of the questionnaire for contact details of people who would like to make themselves available for follow-up interviews or to enter the lucky draw for prizes.

The questionnaire will take you 20 to 30 minutes at most to complete. The majority of questions are in multiple-choice format and ask you to select the most appropriate answer. However, in most cases there is space to provide further comments should you wish to do so.

How are we going to use the results?

This is an anonymous study. We are not trying to find out your identity nor examine the responses on an individual basis. The results of the project will be published, but you may be assured that any information obtained in connection with this study that may be identified with you will remain confidential and will not be disclosed.

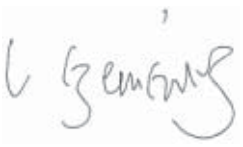
What are we doing to ensure confidentiality?

To ensure security, data is being stored electronically in a database on a secured server and access is restricted to the researchers. Questionnaires will be stored in a locked storage room until no longer required.

Lucky Prizes

Completed questionnaires will be entered in a lucky draw for a number of prizes. (However you will need to fill in your name on the last page of the questionnaire to enable us to contact you should you be a winner).

Please keep this information sheet and if at any stage you have any queries or concerns regarding your participation in the study, please contact us.



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Phone: 021 650 5035

A: Access to ICTs*

*We use the acronym ICTs (Information and Communication Technologies) to refer to computers, computer infrastructure (including the Internet), software, and associated technologies such as data-projectors and cell phones

Please mark with a cross (x) or tick (✓) one number for each question. Unless otherwise indicated only select ONE answer.

How do you access ICTs ON your university CAMPUS?

A1

	Never	Monthly	Fortnightly	Weekly	Daily
On average how often do you come onto campus during semester?	①	②	③	④	⑤

Other (*please write*) .....

A2 On campus, what percentage of your **academic** time

do you spend	None	<20%	20-40%	40-60%	60-80%	80-100%
using computers?	①	②	③	④	⑤	⑥
using the Internet specifically?	①	②	③	④	⑤	⑥

A3 Where do you **most often** go to use ICTs on campus?

① Residence ② Faculty computer lab ③ Central computer lab ④ Library

⑤ Anywhere, I have my own Laptop/ Personal Digital Assistant (PDA) or 3G phone ⑥ Other

A4 When you use ICTs on campus, which statement best describes your use?

I usually use ICTs during formal lectures or practicals booked for our class ①

I usually use ICTs in my own time ②

Combination of both ③

A5

	Very difficult	Difficult	Easy	Very easy	N/A
How easy/ difficult is it for you to access ICTs on campus?	①	②	③	④	⑤
How easy/ difficult is it to work in the environment where you use ICTs? (eg noise, safety, privacy)	①	②	③	④	⑤

Why? .....

A6 What **makes it hard** for you to access ICTs **on campus** (eg computers, Internet, labs, software etc)?

A7 What **helps** you in terms of your access to ICTs **on campus** (eg computers, Internet, labs, software etc)?

How do you access ICTs OFF CAMPUS?

A8 Do you use a computer off campus? ① Yes ② No

A9 If yes, where? *(Select between one and three answers)*

① Work ② Where I live ③ Internet café ④ School/ college
⑤ Friend/ relative ⑥ Community centre ⑦ Public library ⑧ Residence
⑨ Other (*please list*) .....

A10 If you have a computer where you live, what type do you **mainly** use? (*Select only one answer*)

① Desktop ② Laptop ③ Personal Digital Assistant (PDA)
④ 3G phone ⑤ Combination (which?) ⑥ Other (please write)

A11 Can you connect to the Internet off campus? ① Yes ② No

If yes, what type of connection do you most often use? (*Select only one answer*)

① Dial up ② Broadband (ADSL) ③ Cell phone (GPRS, 3G, HDDPA)
④ Wireless ⑤ Satellite ⑥ Don't know

A12 Off campus, what percentage of your **academic** time do you spend

	None	<20%	20-40%	40-60%	60-80%	80-100%
using computers?	①	②	③	④	⑤	⑥
using the Internet specifically?	①	②	③	④	⑤	⑥

A13

	Very difficult	Difficult	Easy	Very easy	N/A
How easy/ difficult is it for you to access ICTs off campus?	①	②	③	④	⑤
How easy/ difficult is it to work in the environment where you use ICTs? (eg noise, safety, privacy)	①	②	③	④	⑤

Why? .....

A14 Think about the computer that you **most often** use when off campus. How many people share use of this computer?

① Just me ② 2 people ③ 3 people
④ 4 people ⑤ More than 4 people ⑥ Not applicable

A15 If you share use of a computer, are you the primary (main) user?

① Yes ② No ③ Share equally ④ Not applicable

A16 What **makes it hard** for you to access ICTs **off campus** (eg computers, Internet, software, location etc)?

A17 What **helps** you in terms of your access to ICTs **off campus** (eg computers, Internet, software, location etc)?

What have your EXPERIENCES been using ICTs?

A18 When did you **first** start using a computer?

① <2 years ago ② 2-4 years ago ③ 4-6 years ago
④ 6-10 years ago ⑤ 10-15 years ago ⑥ > 15 years ago

A19 How did you **originally** learn to use a computer? *(Select between one and three answers)*

① Taught myself ② Learnt from family ③ Learnt from friends
④ Through school ⑤ Community course ⑥ Training course at university
⑦ Formal credit bearing course (eg semester long computer science etc) ⑧ Commercial training course (eg ICDL)
⑨ Generally as part of my courses Other (*please write*) .....

A20 How do you acquire **new** computer skills when you need them? *(Select between one and three answers)*

① Teach myself ② Ask family ③ Ask friends
④ Community course ⑤ Training course at university
⑥ Formal credit bearing course (eg semester long computer science etc) ⑦ Commercial training course (eg ICDL)
⑧ Learn as I do my courses ⑨ Other (*please write*) .....

A21 Is your ability to use a computer limited by a disability/ illness? ① Yes ② No

A22 How much of your overall **computer** time do you spend on activities

	None	<20%	20-40%	40-60%	60-80%	80-100%
to help you with your **academic** studies?	①	②	③	④	⑤	⑥
that are **personal** (eg social, recreational)?	①	②	③	④	⑤	⑥
that are related to **employment**?	①	②	③	④	⑤	⑥

A23 How much of your overall **cell phone** time do you spend on activities

	None	<20%	20-40%	40-60%	60-80%	80-100%
to help you with your **academic** studies?	①	②	③	④	⑤	⑥
that are **personal** (eg social, recreational)?	①	②	③	④	⑤	⑥
that are related to **employment**?	①	②	③	④	⑤	⑥

A24 Where do you seek help when you have a problem doing something with ICTs?
(Please rank in order of 1 = first choice, 2 = second choice etc)

..... Problem solve yourself ..... Ask friends
..... Ask family ..... Ask institutional IT support
..... Refer to manual/ help pages ..... Lab assistant/ tutor/ lecturer
..... Other (*please list*) .....

A25 From my perspective

	Poor	Average	Good	Excellent
my knowledge and skills for using ICTs generally are	①	②	③	④
my knowledge and skills for using ICTs specifically for academic work are	①	②	③	④
At my institution				
technical support for using ICTs for my academic work is	①	②	③	④
support for using ICTs in my learning is	①	②	③	④

A26 Please indicate whether you agree or disagree with the following statements	Strongly disagree	Disagree	Strongly agree	Agree	Don't know
I think ICTs are essential for education	①	②	③	④	⑤
My **family** thinks ICTs are essential for education	①	②	③	④	⑤
My **friends** think ICTs are essential for education	①	②	③	④	⑤
ICTs are a professional skill required for my future employment	①	②	③	④	⑤
I feel I have the knowledge/ skills required to use ICTs at university	①	②	③	④	⑤
ICTs increase existing demographic divides amongst students	①	②	③	④	⑤
I am able to access **ICTs** for long enough periods of time for my learning requirements	①	②	③	④	
I am able to access the **Internet** for long enough periods of time for my learning requirements	①	②	③	④	
In terms of my academic needs I have adequate computer access	①	②	③	④	
Internet access	①	②	③	④	

A27 How do you feel about using ICTs for teaching and learning? (Eg do you enjoy it, is it valuable, do you feel you have adequate skills or lack of knowledge, are you concerned about your level of skills/ knowledge in relation to your peers, does the support you receive meet your needs, do you have enough training?)

B: Using ICTs

How do you use ICTs socially?

B1 How often do you	Hardly ever	Sometimes	Often
communicate with other students by email?	①	②	③
participate in email discussion lists / listserves?	①	②	③
participate in IM chat (eg googlechat, skype, MSN messenger, AOL etc.)?	①	②	③
communicate with other students by SMS?	①	②	③
chat with Mixit?	①	②	③
use voice over Internet protocol (VoIP) (eg skype)?	①	②	③
play a computer-based game?	①	②	③
play a web-based game?	①	②	③
use shared resources (eg documents, photos, weblinks, music files)?	①	②	③
upload resources (such as those above) onto the web?	①	②	③
publish your own content (eg on a website, wiki or blog)?	①	②	③

How do lecturers use ICTs for your courses?

B2	None	Very few	About half	Most	All
For how many of your courses do you use ICTs as part of teaching and learning?	①	②	③	④	⑤

B3 Do your **ICT** activities count for marks? ① Yes ② No

*Please indicate 1. How often, on average, **your lecturers** use technology in your courses 2. How helpful that technology is for your learning.*

B4	**Frequency**			**Helpfulness for learning**				
How often *do your lecturers* explain or demonstrate a concept using	Hardly ever	Sometimes	Often	Makes it harder	No help	Some help	Very helpful	N/A
presentation software (eg MS *PowerPoint)*?	①	②	③	①	②	③	④	⑤
standard office applications (eg *Adobe Acrobat Reader, MS Excel*)?	①	②	③	①	②	③	④	⑤
specialised software (eg GIS, concept mapping software, statistical packages)?	①	②	③	①	②	③	④	⑤
audio or video (eg recordings, films)?	①	②	③	①	②	③	④	⑤
images (eg slides)?	①	②	③	①	②	③	④	⑤

Expectations for YOUR use of ICTs at university?

B5 How often **are you asked** to use ICTs to:	Hardly ever	Sometimes	Often
find/use general course information online?	①	②	③
find/use lecture notes or presentation slides?	①	②	③
find/use examples of previous assignments?	①	②	③
access old examination papers?	①	②	③
search for information on the Internet?	①	②	③
find articles and research reports in online databases?	①	②	③
submit an assignment online	①	②	③
communicate with lecturers and tutors by email?	①	②	③
participate in online discussion with peers in your own time (eg discussion forum)?	①	②	③
participate in online discussion with peers at a specific time (eg chat, IM)?	①	②	③

How do YOU use ICTs for your studies?

Please indicate 1. How often, on average, you use technology for your courses 2. How helpful that technology is for your learning.

B6	My use of ICTs for communication	Frequency			Helpfulness for learning				
		Hardly ever	Sometimes	Often	Makes it harder	No help	Some help	Very helpful	N/A
	Communicate with my lecturers by email	①	②	③	①	②	③	④	⑤
	Communicate with other students using ICTs as part of my course	①	②	③	①	②	③	④	⑤
	Participate in an online discussion with peers in my own time eg discussion forum	①	②	③	①	②	③	④	⑤
	Participate in an online discussion with peers at a specific time (eg chat, IM)	①	②	③	①	②	③	④	⑤
	Keep an online journal or blog as part of my course	①	②	③	①	②	③	④	⑤

B7	My use of ICTs for finding or sharing information	Frequency			Helpfulness for learning				
		Hardly ever	Sometimes	Often	Makes it harder	No help	Some help	Very helpful	N/A
	Search for information on the Internet as part of my course (eg Google)	①	②	③	①	②	③	④	⑤
	Search for articles and research reports in online databases (eg electronic journals)	①	②	③	①	②	③	④	⑤
	Search for general course information online	①	②	③	①	②	③	④	⑤
	Search for lecture notes or presentation slides online	①	②	③	①	②	③	④	⑤
	Search for examples of old student assignments online	①	②	③	①	②	③	④	⑤
	Access old examination papers online	①	②	③	①	②	③	④	⑤
	Use a course website or online learning environment (eg WebCT)	①	②	③	①	②	③	④	⑤
	Share resources eg photos, weblinks, music etc as part of my course (eg Flickr, De.lic.ious)	①	②	③	①	②	③	④	⑤
	Work with other students on an online document (eg. using a Wiki)	①	②	③	①	②	③	④	⑤

Please indicate your opinion on the following statements.

		Never	Sometimes	Often	Don't know
B8	I am able to find content on the Internet that is **relevant to my courses**	①	②	③	④
B9	I am able to find content on the Internet that is **relevant to South Africa**	①	②	③	④
B10	I am able to find content on the Internet that has been **produced in South Africa**	①	②	③	④
B11	The Internet resources I use for studying are available in the **language I want**	①	②	③	④
B12	The Internet resources I use for studying are available in **my home language**	①	②	③	④

Can you give examples of Internet sites or online content that you find most useful for your studies? (*Please list*)

.....

B13 My use of ICTs for activities

	Frequency			Helpfulness for learning				
	Hardly ever	Sometimes	Often	Makes it harder	No help	Some help	Very helpful	N/A
Complete a computer-based quiz for self-testing	①	②	③	①	②	③	④	⑤
Complete a computer-based test for marked assessment	①	②	③	①	②	③	④	⑤
Complete a computer-based tutorial	①	②	③	①	②	③	④	⑤
Play a computer-based game as part of my course	①	②	③	①	②	③	④	⑤
Use a computer-based simulation or modelling program	①	②	③	①	②	③	④	⑤

B14 My use of ICTs for production or creation

	Frequency			Helpfulness for learning				
	Hardly ever	Sometimes	Often	Makes it harder	No help	Some help	Very helpful	N/A
Submit a word-processed essay	①	②	③	①	②	③	④	⑤
Create a poster or presentation (eg using *PowerPoint*)	①	②	③	①	②	③	④	⑤
Develop a website or multimedia production	①	②	③	①	②	③	④	⑤
Design a prototype or plan, or construct a model using specialised software (eg CAD, GIS)	①	②	③	①	②	③	④	⑤
Create a database or spreadsheets using computer software (eg *Excel* or *Access*)	①	②	③	①	②	③	④	⑤
Develop a personal bibliography using bibliographic management software (eg *Endnote, Citation, Refworks*)	①	②	③	①	②	③	④	⑤
Develop my academic writing skills (eg referencing) using plagiarism detection software	①	②	③	①	②	③	④	⑤

Are there any other activities for which you use a ICTs for learning that we haven't mentioned? (*Please list*)

.....

B15 My use of a cell phone at university

	Frequency			Helpfulness for learning				
	Hardly ever	Sometimes	Often	Makes it harder	No help	Some help	Very helpful	N/A
Receive information from my university via my cell phone	①	②	③	①	②	③	④	⑤
Use my cell phone for something related to my studies (eg find information, get help from friends)	①	②	③	①	②	③	④	⑤

Are there any other activities for which you use a cell phone in your learning that we haven't mentioned? (*Please list*)

.....

B16 Do you think ICTs help you with your learning by improving your ability to

	Yes	Sometimes	No	Don't know	Can you give examples?
recall facts, basic concepts and answers?	①	②	③	④	.....
understand concepts and ideas?	①	②	③	④	.....
analyse information?	①	②	③	④	.....
solve problems?	①	②	③	④	.....
make judgments about information?	①	②	③	④	.....

What other skills do you hope to gain by using ICTs in your courses at University? (Eg skills, attributes, abilities). (*Please list*)

.....

B17 What **don't you like** about using a ICTs for learning? (Eg things that are a waste of time, not valuable, don't help you at all).

B18 What do you find **valuable** about using a ICTs for learning? (Eg things you do that really help you, make studying easier, improve your learning).

B19 Are there any additional comments you wish to make about your access to or use of ICTs for studying?

C: Information about yourself

Please tick one box for each question or write the appropriate response in the space provided.

We are requesting some personal information from each participant to assist in analysis of our results as our previous research and the literature indicates that social background, age, gender and language may influence use of computers. We are also requesting information about the courses you are studying as we believe there are differences in the use of computers across disciplines. **This information will remain anonymous.**

C1 Your institution (*please write*)

.....

.....

C2 Your faculty (*please write*)

.....

.....

C3 Your campus (*please write*)

.....

.....

C4 Qualification for which you are studying

① Undergrad certificate / diploma
② Bachelors degree
③ Postgrad coursework
④ Postgrad thesis
⑤ Postgrad certificate / diploma
⑥ Other

C5 Age (*please write*).....

C6 Current level of study

① 1st year
② 2nd year
③ 3rd year
④ 4th year
⑤ 5th year
⑥ Other

C7 Home language (language you speak most often at home)

① Afrikaans
② English
③ isiNdebele
④ Sesotho (N)
⑤ Sesotho (S)
⑥ siSwati
⑦ Sepedi
⑧ Xitsonga
⑨ Setswana
⑩ Tshivenda
⑪ isiXhosa
⑫ isiZulu
⑬ Other African
⑭ Other international

C8 Gender

① Male
② Female

C9 Nationality

① South African
② SADC
③ Other African
④ International

C10 Occupation of the primary breadwinner / guardian in your family. (*please write*)

.....

C11 Highest education of the primary breadwinner / guardian in your family. (*please write*)

.....

C12 Are you the first person in your immediate household to go to university?

① Yes
② No

Optional

If you would like to give us your name and contact information you can enter a lucky draw to win some fabulous prizes to make your access to ICTs just that bit easier. You can also let us know if you are willing to participate in a follow up email/phone interview.

Please tick the relevant box

I would like to be entered in the lucky draw for a prize ☐

I am available for a possible follow-up interview ☐

Name: .....

Cell / phone number.....

Email:.....

Prizes

1 x Laptop worth R6000

1 x Ipod nano 1GB

1 x Digital camera 5MP

3 x MS Student Office (sponsored by Microsoft SA)

10 x 1Gb flash drives

20 x R100 cell phone vouchers